BIOLOGY

NEET

Team 37 Kohinoor

Years

(2024-1988)

CHAPTER & TOPIC-WISE SOLUTIONS

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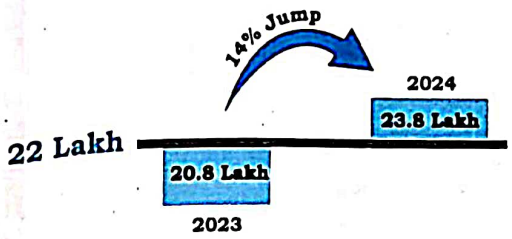
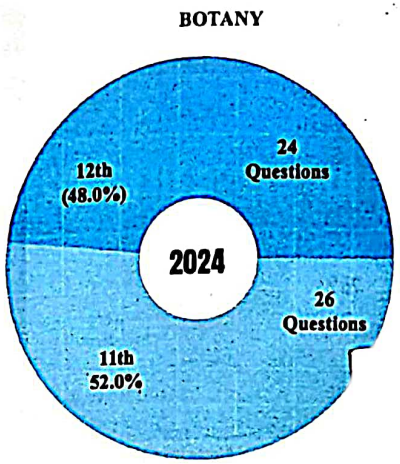
NEET BLUEPRINT: ANALYZING PATTERNS FOR EXAM MASTERY

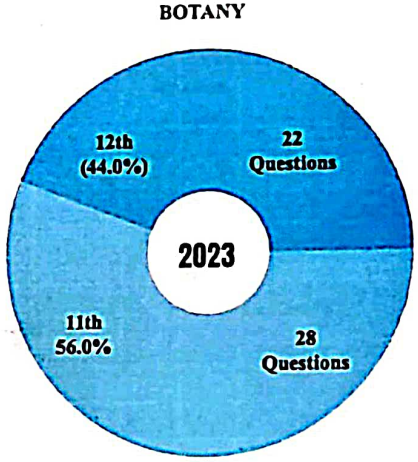
Registered Candidate Comparison

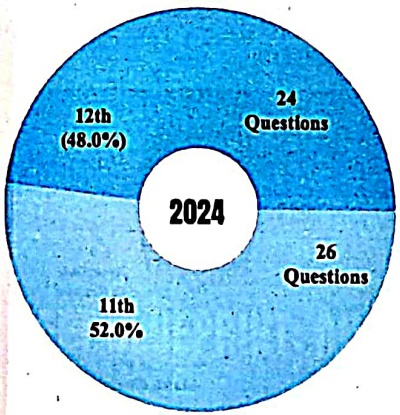


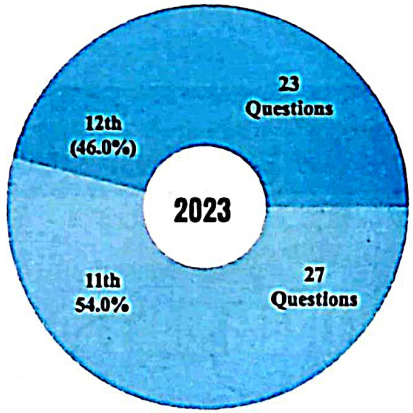
		2023	2024	
Female		11.8 Lakh	13.6 Lakh	↗
Male		9 Lakh	10.18 Lakh	↗

Class-wise Comparison









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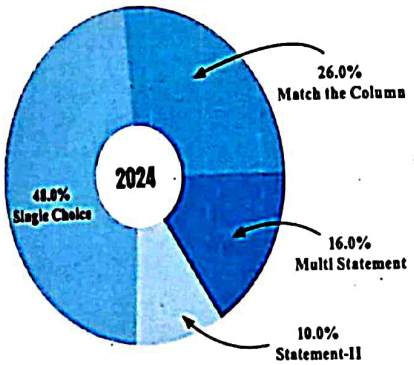
Question Type Analysis (NEET 2024)

Subject	Single Choice	Statement II	Multi Statement	Assertion & Reason	Match the Column	Grand Total
Physics	44	1	2	1	2	50
Chemistry	37	5	1	0	7	50
Botany	24	5	8	0	13	50
Zoology	17	5	8	2	18	50
Total	122	16	19	3	40	50

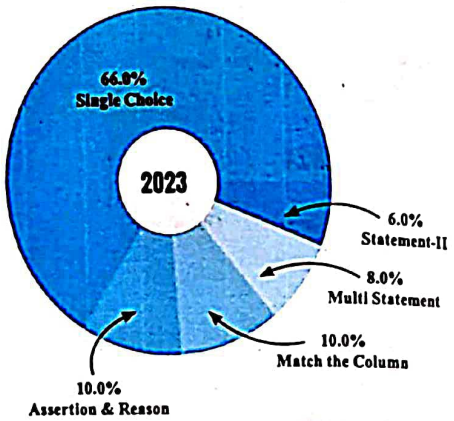
Question Type Analysis (NEET 2023)

Subject	Single Choice	Statement II	Multi Statement	Assertion & Reason	Match the Column	Grand Total
Physics	48	2	0	0	0	50
Chemistry	38	2	4	4	2	50
Botany	33	3	4	5	5	50
Zoology	19	8	7	3	13	50
Total	138	15	15	12	20	200

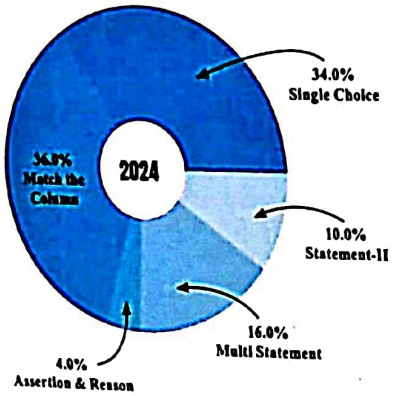
BOTANY



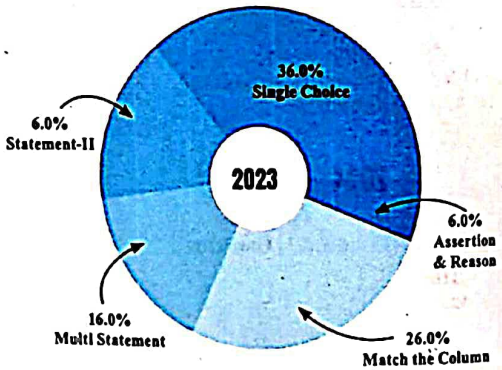
BOTANY



ZOOLOGY



ZOOLOGY



YEAR WISE NUMBER OF QUESTIONS

Biology Class-XI

Year Wise Number of Questions

Chapters Name	2024	2023	2023 Manipur	2022	2022 Re	2021	2020	2020 Covid	2019	2018	2017	2016 II	2016 I	2015	2015 Re
The Living World	0	0	2	1	1	1	0	0	1	1	0	2	0	0	0
Biological Classification	2	0	0	2	2	1	1	1	2	5	3	3	5	3	7
Plant Kingdom	1	3	3	3	2	4	3	3	2	3	5	2	1	3	0
Animal Kingdom	3	4	2	2	2	4	4	4	2	3	4	1	4	4	3
Morphology of Flowering Plants	5	2	3	3	3	2	3	3	1	2	4	4	4	4	4
Anatomy of Flowering Plants	3	4	3	3	3	1	2	2	3	4	3	2	1	2	1
Structural Organisation in Animals	4	4	4	4	5	4	3	3	2	1	1	2	2	1	3
Cell: The Unit of Life	4	2	2	4	1	2	4	4	6	2	3	2	2	6	7
Biomolecules	6	3	4	3	6	4	4	2	3	1	2	3	1	1	1
Cell Cycle and Cell Division	4	6	5	4	5	5	4	4	2	1	3	3	2	1	2
Photosynthesis in Higher Plants	3	3	3	2	2	2	2	2	0	1	2	2	3	0	1
Respiration in Plants	2	2	2	3	3	1	1	1	2	2	1	2	0	1	0
Plant Growth and Development	3	3	3	3	3	3	3	3	2	0	1	1	1	2	2
Breathing and Exchange of Gases	3	3	3	2	2	2	2	2	0	1	2	2	3	0	1
Body Fluids and Circulation	2	2	2	2	2	2	2	2	2	2	2	1	1	3	3
Excretory Products and their Elimination	2	2	2	1	0	0	2	0	2	2	2	1	1	2	1
Locomotion and Movement	2	2	1	2	2	3	1	1	2	1	3	2	1	1	1
Neural Control and Coordination	2	2	2	1	2	0	1	1	2	3	2	1	1	2	2
Chemical Coordination and Integration	2	2	2	1	3	1	4	3	2	2	2	4	2	1	2

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Class - XI

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CHAPTER 1

The Living World

What is living?

1. Which one of the following aspects is an exclusive characteristic of living things? [MR*] *(2011 Mains)*
   a. Perception of events happening in the environment and their memory
   b. Increase in mass by accumulation of material both on surface as well as internally
   c. Isolated metabolic reactions occur *in vitro*
   d. Increase in mass from inside only
2. A living organism can be unexceptionally differentiated from a non living thing on the basis of its ability for: *(2007)*
   a. Reproduction
   b. Growth and movement
   c. Responsiveness to touch
   d. Interaction with environment and progressive evolution
3. Biological organisation begins at: *(2007)*
   a. Cellular level
   b. Atomic level
   c. Organismic level
   d. Submicroscopic molecular level.

Diversity in The Living World

4. 'X' and 'Y' are the components of Binomial nomenclature. This naming system was proposed by 'Z': *(2023-Manipur)*
   a. X-Generic name, Y-Specific epithet, Z-Carolus Linnaeus
   b. X-Specific epithet, Y-Generic name, Z-R.H. Whittaker
   c. X-Specific epithet, Y-Generic name, Z-Carolus Linnaeus
   d. X-Generic name, Y-Specific epithet, Z-R.H. Whittaker
5. Select the correctly written scientific name of Mango which was first described by Carolus Linnaeus. [MR*] *(2019)*
   a. *Mangifera indica* Car. Linn.
   b. *Mangifera indica* Linn.
   c. *Mangifera indica*
   d. Mangifera Indica
6. Study the four statements (A–D) given below and select the two correct ones out of them: [MR*] *(2016 - II)*
   A. Definition of biological species was given by Ernst Mayr.
   B. Photoperiod does not affect reproduction in plants.
   C. Binomial nomenclature system was given by R.H. Whittaker.
   D. In unicellular organisms, reproduction is synonymous with growth.

   The two correct statements are
   a. A and D b. A and B
   c. B and C d. C and D
7. Biodiversity of a geographical region represents: *(2011 Mains)*
   a. Genetic diversity present in the dominant species of the region
   b. Species endemic to the region
   c. Endangered species found in the region
   d. The diversity in the organisms living in the region
8. ICBN is: *(2007)*
   a. International Code for Biological Naming
   b. International Code for Botanical Nomenclature
   c. International Class for Biological Nomenclature
   d. International Classification for Biological Nomenclature
9. Biosystematics aims at: *(2003)*
   a. The classification of organisms based on broad morphological characters
   b. Delimiting various taxa of organisms and establishing their relationships
   c. The classification of organisms based on their evolutionary history and establishing their phylogeny on the totality of various parameters from all fields of studies
   d. Identification and arrangement of organisms on the basis of their cytological characteristics
10. Linnaeus is credited with: *(1993)*
    a. Binomial nomenclature
    b. Theory of biogenesis
    c. Discovery of microscope
    d. Discovery of blood circulation

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11. Linnaeus evolved a system of nomenclature called: *(1990)*
a. Mononomial b. Vernacular
c. Binomial d. Polynomial

12. The term "New Systematics" was introduced by: [OS] *(1988)*
a. Linnaeus b. Bentham and Hooker
c. Julian Huxley d. A. P. de Candolle

13. Static concept of species was put forward by: [OS] *(1988)*
a. de Candolle b. Linnaeus
c. Theophrastus d. Darwin

Taxonomic Categories

14. House fly belongs to ..... family. *(2023-Manipur)*
a. Cyprinidae b. Hominidae
c. Calliphoridae d. Muscidae

15. In the taxonomic categories which hierarchial arrangement in ascending order is correct in case of animals? [MR*] *(2022)*
a. Kingdom, Order, Phylum, Class, Family, Genus, Species
b. Kingdom, Phylum, Class, Order, Family, Genus, Species
c. Kingdom, Class, Phylum, Family, Order, Genus, Species
d. Kingdom, Order, Class, Phylum, Family, Genus, Species

16. Which one of the following belongs to the family Muscidae? *(2021)*
a. Grasshopper b. Cockroach
c. Housefly d. Fire fly

17. Match Column-I with Column-II for housefly classification and select the correct option using the codes given below: [MR^] *(2016 - II)*

	Column - I		Column - II
A.	Family	(i)	Diptera
B.	Order	(ii)	Arthropoda
C.	Class	(iii)	Muscidae
D.	Phylum	(iv)	Insecta

Codes:
a. A-iv B-iii C-ii D-i
b. A-iv B-ii C-i D-iii
c. A-iii B-i C-iv D-ii
d. A-iii B-ii C-iv D-i

18. Which of the following organisms is scientifically correctly named, correctly printed according to International Rules of Nomenclature and correctly described? *(2012 Mains)*
a. *Musca domestica*-The common house lizard, a reptile
b. *Plasmodium falciparum*-A protozoan pathogen causing the most serious type of malaria
c. *Felis tigris*-The Indian tiger, well protected in Gir Forests.
d. *E. coli*-Full name *Entamoeba coli*, a commonly occurring bacterium in human intestine.

19. Which one of the following animals is correctly matched with its particular named taxonomic category? [MR^] *(2011 Pre)*
a. Housefly - *Musca*, an order
b. Tiger - *Tigris*, the species
c. Cuttlefish - Mollusca, a class
d. Humans - Primata, the family

20. Species are considered as: [OS] *(20...*
a. Real basic units of classification
b. The lowest units of classification
c. Artificial concept of human mind
d. Real units of classification devised by taxonomists

21. Which of the following is less general in characters as compared to genus? *(20...*
a. Species b. Division
c. Class d. Family

22. Practical purpose of taxonomy or classification: *(199...*
a. Facilitate the identification of unknown species
b. Explain the origin of organisms
c. To know the evolutionary history
d. Identification of medicinal plants

23. Which arrangement is in correct ascending order? *(199...*
a. Species < Genus < Order < Family
b. Genus < Species < Family < Order
c. Order < Family < Genus < Species
d. Species < Genus < Family < Order

24. 'Taxon' is the unit of a group of: *(199...*
a. Order b. Taxonomy
c. Species d. Genus

25. Gorilla, chimpanzee, monkeys and human belong to the same: *(199...*
a. Species b. Genus
c. Family d. Order

26. Sequence of taxonomic categories is: *(199...*
a. Class-phylum-tribe-order-family-genus-species
b. Division-class-family-tribe-order-genus-species
c. Division-class-order-family-tribe-genus-species
d. Phylum-order-class-tribe-family-genus-species

27. The term phylum was given by: [OS] *(199...*
a. Cuvier b. Haeckel
c. Theophrastus d. Linnaeus

28. A group of plants or animals with similar traits of any rank is: *(1992, 19...*
a. Species b. Genus
c. Order d. Taxon

29. A taxon is: *(199...*
a. A group of related familes
b. A group of related species
c. A type of living organisms
d. A taxonomic group of any ranking

30. Basic unit or smallest taxon of taxonomy/classification is *(199...*
a. Species b. Kingdom
c. Family d. Variety

Answer Key

1. (a)	2. (c)	3. (d)	4. (a)	5. (b)	6. (a)	7. (d)	8. (b)	9. (c)	10. (a)
11. (c)	12. (c)	13. (b)	14. (d)	15. (None)	16. (c)	17. (c)	18. (b)	19. (b)	20. (a)
21. (a)	22. (a)	23. (d)	24. (b)	25. (d)	26. (c)	27. (b)	28. (d)	29. (d)	30. (a)

Explanations

1. **(a)** The most obvious and technically complicated feature of all living organisms is the ability to sense their surroundings or environment and respond to these environmental stimuli which could be physical, chemical or biological.

2. **(c)** The most complicated feature of all living organisms is the ability to sense their surroundings or environment and respond to these environmental stimuli which could be physical, chemical or biological.

3. **(d)** Biological organisation starts with submicroscopic molecular level.

4. **(a)** X-Generic name, Y-Specific epithet, Z-Carolus Linnaeus

   In Binomial nomenclature, 'X' represents the Generic name, 'Y' represents the Specific epithet, and 'Z' is Carolus Linnaeus, who proposed this system. This naming convention is universally used in the classification and naming of organisms.

5. **(b)** According to rules of binomial nomenclature, correctly written scientific name of mango is *Mangifera indica* Linn.

6. **(a)** Photoperiod affects reproduction in seasonal breeders, both in plants and animals.

   Binomial nomenclature system was given by Carolus Linnaeus and is being practiced by biologists all over the world.

7. **(d)** Biodiversity refers to all of the species (including plants, bacteria, animals and humans) that are present in one region or ecosystem.

8. **(b)** ICBN: International code for Botanical Nomenclature

9. **(c)** Biosystematics aims at the classification of organisms based on their evolutionary history and establishing their phylogeny on the totality of various parameters from all fields of studies.

10. **(a)** Binomial nomenclature was given by Carolus Linnaeus.

11. **(c)** Binomial nomenclature has two components - generic name & specific epithet.

12. **(c)** Julian Huxley introduced the term 'New Systematics'.

13. **(b)** According to static concept of species, species are unchangeable over the course of time & evolution. It was stated by Linnaeus.

14. **(d)** The house fly belongs to the Muscidae family.

15. **(None)** The taxonomic hierarchy was introduced by Linnaeus. It is also known as a Linnaean hierarchy. It is used to classify organisms into different categories. It includes the sequence of categories in a descending order from kingdom to species and vice versa.

    The descending order of the taxonomic hierarchy is - Kingdom, Phylum (Division), Class, Order, Family, Genus, and Species.

16. **(c)** House fly belongs to family Muscidae.

17. **(c)** Family - Muscidae
    Order - Diptera
    Class - Insecta
    Phylum - Arthropoda

18. **(b)** In binomial nomenclature, the scientific name consists of two words. The first word represents genus and starts with a capital word. The second word represents specific epithet and starts with a small letter. *Musca domestica* is a housefly. *Panthera tigris* is the Indian tiger. The full name of *E. coli* is *Escherichia coli*. *Plasmodium*, a tiny protozoan, is responsible for malarial disease.

19. **(b)** Human : *Homo* (Genus), *sapiens* (species), Hominidae (family)
    Housefly : *Musca* (genus), *domestica* (species)
    Tiger : *Panthera* (genus), *tigris* (species)
    Cuttlefish : Mollusca (phylum)

20. **(a)** Species is a group of individual organisms with fundamental similarities, so they are considered as real basic unit of classification.

21. **(a)** Genus has more characters in common in comparison to species of other genera. Thus, genera are aggregates of closely related species and species are less general in characters than genus.

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22. (a) Through classification, unknown species are grouped into convenient categories based on observable characters and thus easily identified.

23. (d) Hierarchical arrangement of taxonomic categories in ascending order:
Species → Genus → Family → Order → Class → Phylum / Division → Kingdom.

24. (b) Taxonomy : Branch of science concerned with grouping & naming biological organisms (or classification)
Taxon : Unit of classification.

25. (d) Gorilla, chimpanzee, monkeys and humans belong to t same order, i.e., primates.

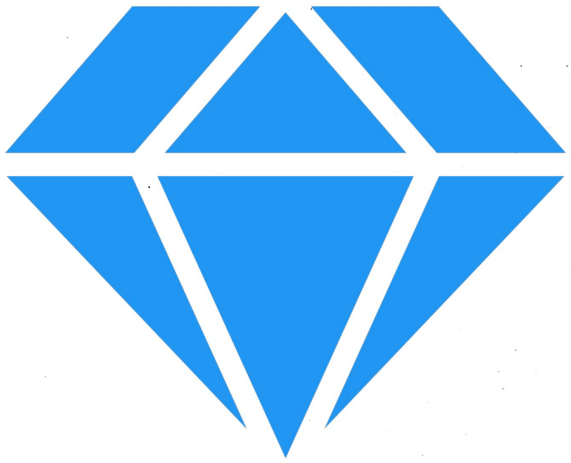
26. (c) Sequence; Division - a Class - Order - Family - Tri Genus - Species, is correct.

27. (b) Ernst Haeckel coined the term phylum in 1866.

28. (d) Taxon is a unit of classification represents any ra e.g., at basic rank taxon is called species and then ge and so on.

29. (d) Taxon is a classification group of any rank.

30. (a) Species is the basic unit of classification.



CHAPTER 2

Biological Classification

Introduction

1. Five kingdom system of classification suggested by R.H. Whittaker is not based on [MR*] *(2014)*
   a. Complexity of body organisation
   b. Presence or absence of a well defined nucleus
   c. Mode of reproduction
   d. Mode of nutrition

2. In the five-kingdom classification, *Chlamydomonas* and *Chlorella* have been included in: *(2012 Mains)*
   a. Protista b. Algae
   c. Plantae d. Monera

3. In which kingdom would you classify the archaea and nitrogen-fixing organisms, if the five-kingdom system of classification is used? *(2003)*
   a. Plantae b. Fungi
   c. Protista d. Monera

4. In five kingdom system, the main basis of classification: *(2002)*
   a. Structure of nucleus b. Mode of nutrition
   c. Structure of cell wall d. Asexual reproduction

5. According to five kingdom system, blue green algae belongs to: *(1998)*
   a. Metaphyta b. Monera
   c. Protista d. Algae

6. An important criterion of modern day classification is: *(1991)*
   a. Resemblances in morphology
   b. Anatomical and physiological traits
   c. Breeding habits
   d. Presence or absence of notochord

Kingdom Monera

7. Which of the following is a correct statement? [MR*] *(2022)*
   a. Mycoplasma have DNA, Ribosome and cell wall
   b. Cyanobacteria are a group of autotrophic organisms classified under Kingdom Monera
   c. Bacteria are exclusively heterotrophic organisms
   d. Slime moulds are saprophytic organisms classified under Kingdom Monera.

8. Which of the following is incorrect about Cyanobacteria? [MR*] *(2020-Covid)*
   a. They lack heterocysts
   b. They often form blooms in polluted water bodies
   c. They have chlorophyll 'a' similar to green plants
   d. They are photoautotrophs

9. Oxygen is **not** produced during photosynthesis by *(2018)*
   a. *Nostoc* b. Green sulphur bacteria
   c. *Cycas* d. *Chara*

10. Which of the following are found in extreme saline conditions? *(2017-Delhi)*
    a. Archaebacteria b. Eubacteria
    c. Cyanobacteria d. Mycobacteria

11. Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen? *(2017-Delhi)*
    a. *Bacillus* b. *Pseudomonas*
    c. Mycoplasma d. *Nostoc*

12. Methanogens belong to: *(2016 - II)*
    a. Dinoflagellates b. Slime moulds
    c. Eubacteria d. Archaebacteria

13. Which one of the following statements is wrong? [MR*] *(2016 - I)*
    a. *Cyanobacteria* are also called blue-green algae
    b. Golden algae are also called desmids
    c. Eubacteria are also called false bacteria
    d. Phycomycetes are also called algal fungi

14. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the: *(2016 - I)*
    a. Halophiles b. Thermoacidophiles
    c. Methanogens d. Eubacteria

15. True nucleus is absent in: *(2015)*
    a. *Vaucheria* b. *Volvox*
    c. *Anabaena* d. *Mucor*

16. The gut of cow and buffalo possess: *(2015)*
    a. Methanogens b. *Cyanobacteria*
    c. *Fucus* d. *Chlorella*

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17. Cell wall is absent in: *(2015 Re)*
a. *Funaria* b. Mycoplasma
c. *Nostoc* d. *Aspergillus*

18. Archaebacteria differ from Eubacteria in: *(2014)*
a. Mode of reproduction b. Cell membrane structure
c. Mode of nutrition d. Cell shape

19. Nuclear membrane is absent in: *(2012 Pre)*
a. *Nostoc* b. *Penicillium*
c. *Agaricus* d. *Volvox*

20. The Cyanobacteria are also referred to as: *(2012 Pre)*
a. Blue green algae b. Protists
c. Golden algae d. Slime moulds

21. The most abundant prokaryotes helpful to humans in making curd from milk and in production of antibiotics are the ones categorized as: *(2012 Pre)*
a. Heterotrophic bacteria b. Cyanobacteria
c. Archaebacteria d. Chemosynthetic autotrophs

22. Maximum nutritional diversity is found in the group: *(2012 Pre)*
a. Plantae b. Fungi
c. Animalia d. Monera

23. In eubacteria, a cellular component that resembles eukaryotic cell is: *(2011 Pre)*
a. Cell wall b. Plasma membrane
c. Nucleus d. Ribosome

24. Organisms called Methanogens are most abundant in a: *(2011 Pre)*
a. Hot spring b. Sulphur rock
c. Cattle yard d. Polluted stream

25. Oxygenic occurs in: **[OS]** *(2009)*
a. *Chlorobium* b. *Chromatium*
c. *Oscillatoria* d. *Rhodospirillium*

26. *Thermococcus*, *Methanococcus* and *Ethanobacterium* exemplify: **[MR*]** *(2008)*
a. Bacteria whose DNA is relaxed or positively supercoiled but which has a cytoskeleton as well as mitochondria
b. Bacteria that contain a cytoskeleton and ribosome
c. Archaebacteria that contain proteins homologous to eukaryotic core histones
d. Archaebacteria that lack any histones resembling those found in eukaryotes but whose DNA is negatively supercoiled

27. Which one is true about domain archaea? *(2008)*
a. They differ from both prokaryotes and eukaryotes
b. They completely differ from prokaryotes
c. They resemble eukaryote in all aspects
d. They have some novel features absent in other prokaryotes and eukaryotes

28. Which is wrong about Mycoplasma? *(2007)*
a. They are called PPLO
b. They are pleomorphic
c. They are sensitive to penicillin
d. They cause diseases in plants

29. The bacterium (*Clostridium botulinum*) that causes bo... is: **[OS]** *(1...*
a. Obligate aerobe
b. Facultative aerobe
c. Facultative anaerobe
d. Obligate anaerobe

30. Barophilic prokaryotes: **[OS]** *(1...*
a. Occur in water containing high concentration of ba... hydroxide
b. Grow slowly in alkaline frozen lakes at high altitude
c. Grow and multiply in very deep marine sediments
d. Readily grow and divide in sea water enriched w... soluble salt of barium.

31. Which statement is correct for bacterial transduction? **[OS]** *(20...*
a. Transfer of some genes from one bacteria to ano... bacteria through virus
b. Transfer of genes from one bacteria to another bac... by conjugation
c. Bacteria obtained its DNA directly
d. Bacteria obtained DNA from other external source

32. Organisms which obtain energy by the oxidation of redu... inorganic compounds are called: *(20...*
a. Photoautotrophs b. Chemoautotrophs
c. Saprozoic d. Chemoheterotrophs

33. What is true for cyanobacteria? **[MR*]** *(20...*
a. Oxygenic with nitrogenase
b. Oxygenic without nitrogenase
c. Non-oxygenic with nitrogenase
d. Non-oxygenic without nitrogenase

34. What is true for Archaebacteria? *(200...*
a. All halophiles b. All photosynthetic
c. All fossils d. Oldest living beings

35. What is true for photolithotrophs? **[OS]** *(200...*
a. Obtain energy from radiations and hydrogen from organ... compounds
b. Obtain energy from radiations and hydrogen fro... inorganic compounds
c. Obtain energy from organic compounds
d. Obtain energy from inorganic compounds

36. Which of the following survives a temperature of 104°C b... 106°C? *(199...*
a. Marine Archaebacteria
b. Hot water spring thermophiles
c. Seeds of angiosperms
d. Eubacteria

37. Transduction in bacteria carried out by: **[OS]** *(199...*
a. Bacteriophage b. B.G.A.
c. *Mycoplasma* d. Rickettsiae

38. The hereditary material present in the bacterium *E. coli* is: *(199...*
a. Single-stranded DNA b. Double-stranded DNA
c. DNA d. RNA

39. BGA (blue green algae) are included in which of the following groups? *(1996)*
a. Bryophytes b. Prokaryotes
c. Protista d. Fungi

40. *Azotobacter* and *Bacillus polymyxa* are the examples of: *(1996)*
a. Pathogenic bacteria b. Decomposers
c. Symbiotic N_2 fixer d. Non-symbiotic N_2 fixer

41. Which are the sex organs provided in some bacteria? *(1996)*
a. Sex pili b. Plasmid
c. Circular DNA d. Gametes

42. Which type of DNA is found in bacteria? *(1996)*
a. Circular free DNA b. Membrane bound DNA
c. Straight DNA d. Helical DNA

43. The tailed bacteriophages are: **[OS]** *(1995)*
a. Motile on surface of bacteria
b. Non-motile
c. Motile on surface of plant leaves
d. Actively motile in water

44. A large number of organic compounds can be decomposed by: **[OS]** *(1995)*
a. *Azotobacter* b. Chemolithotrophs
c. *Mycoplasma* d. *Pseudomonas*

45. Organisms, which fix atmospheric nitrogen in the soil, fall under the category of: *(1994)*
a. Bacteria b. Green algae
c. Soil fungi d. Mosses

46. Transduction in bacteria is mediated by: **[OS]** *(1994)*
a. Plasmid vectors
b. Phage vectors
c. Cosmids
d. F-factors

47. Genophore/bacterial genome or nucleoid is made of: *(1993)*
a. Histones and non-histones
b. RNA and histones
c. A single double stranded DNA
d. A single stranded DNA

48. *Escherichia coli* is used extensively in biological research as it is: *(1993)*
a. Easily cultured
b. Easily available
c. Easy to handle
d. Easily multiplied in host

49. Bacteria lack alternation of generation because there is: **[OS]** *(1992, 1991)*
a. Neither syngamy nor reduction division
b. Distinct chromosomes are absent
c. No conjugation
d. No exchange of genetic material

50. Name the organisms which do not derive energy directly or indirectly from sun: *(1991)*
a. Chemosynthetic bacteria
b. Pathogenic bacteria
c. Symbiotic bacteria
d. Mould

51. Which one belongs to Monera? *(1990)*
a. *Amoeba* b. *Escherichia*
c. *Gelidium* d. *Spirogyra*

52. Many blue-green algae occur in thermal springs (hot water springs). The temperature tolerance of these algae have been attributed to their: *(1994)*
a. Mitochondrial structure
b. Importance of homopolar bonds in th...
c. Cell wall structure
d. Modern cell organisation

Kingdom Protis...

53. Select the **wrong** statement
a. Cell wall is present in members of Fungi and Plantae
b. Mushrooms belong to Basidiomycetes
c. Pseudopodia are locomotory and feeding structures in Sporozoans
d. Mitochondria are the powerhouse of the cell in all kingdoms except Monera

54. Which of the following organisms are known as chief producers in the oceans? **[MR*]** *(2018)*
a. Dinoflagellates b. Diatoms
c. Cyanobacteria d. Euglenoids

55. Ciliates differ from all other protozoans in *(2018)*
a. Using flagella for locomotion
b. Having a contractile vacuole for removing excess water
c. Using pseudopodia for capturing prey
d. Having two types of nuclei

56. Select the wrong statement: *(2016 - II)*
a. Diatoms are chief producers in the oceans
b. Diatoms are microscopic and float passively in water
c. The walls of diatoms are easily destructible
d. 'Diatomaceous earth' is formed by the cell wall of diatoms.

57. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom: *(2016 - I)*
a. Animalia b. Monera
c. Protista d. Fungi

58. In which group of organisms the cell walls form two thin overlapping shells which fit together? **[MR*]** *(2015 Re)*
a. Euglenoids b. Dinoflagellates
c. Slime moulds d. Chrysophytes

59. Which one is a slime mould? *(2007)*
a. *Physarum* b. *Rhizopus*
c. *Anabaena* d. *Thiobacillus*

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60. Which is common about *Trypanosoma*, *Noctiluca*, *Monocystis* and *Giardia*? *(2006)*
a. They are all parasites
b. They are all unicellular protists
c. They have flagella
d. They produce spores

61. Thalloid body of a slime mould (myxomycetes) is known as: *(2006)*
a. Mycelium b. Protonema
c. Plasmodium d. Fruiting body

62. Auxospores and hormocysts are formed respectively by: [OS] *(2005)*
a. Some diatoms and several Cyanobacteria
b. Some Cyanobacteria and several diatoms
c. Several Cyanobacteria and several diatoms
d. Several diatoms and a few Cyanobacteria

63. Which unicellular organism has a macronucleus for trophic function and one or more micronuclei for reproduction? [OS] *(2005)*
a. *Euglena* b. *Amoeba*
c. *Paramecium* d. *Trypanosoma*

64. When a fresh water protozoan possessing a contractile vacuole, is placed in a glass containing marine water, the vacuole will: [OS] *(2004)*
a. Disappear b. Increase in size
c. Decrease in size d. Increase in number

65. Diatomaceous earth is used as heat insulator in boilers and steam pipes because the cell wall of diatom: *(1999)*
a. Composed of Iron
b. Composed of Silicon dioxide
c. Is conductor of heat
d. Is bad conductor of electricity

66. The protists have: *(1994)*
a. Only free nucleic acid aggregates
b. Membrane bound nucleoproteins lying embedded in the cytoplasm
c. Gene containing nucleoproteins condensed together in loose mass
d. Nucleoprotein in direct contact with the rest of the cell substance

67. Which of the following organisms possesses characteristics of a plant and an animal? *(1995)*
a. *Euglena* b. *Paramoecium*
c. Bacteria d. *Mycoplasma*

68. The function of contractile vacuole, in protozoa, is: *(1995)*
a. Osmoregulation b. Reproduction
c. Locomotion d. Digestion of food

69. If all ponds and puddles are destroyed, the organism likely to be destroyed is: [OS] *(1993)*
a. *Leishmania* b. *Trypanosoma*
c. *Ascaris* d. *Plasmodium*

70. Who discovered *Plasmodium* in R.B.C. of human
a. Ronald Ross b. Mendel
c. Laveran d. Stephens

71. *Trypanosoma* belongs to class:
a. Sarcodina b. Zooflagellata
c. Ciliata d. Sporozoa

Kingdom Fungi

72. Which of the following statements is correct? [MR*]
a. Fusion of protoplasms between two motile or non-
gametes is called plasmogamy.
b. Organisms that depend on living plants are
saprophytes.
c. Some of the organisms can fix atmospheric nitro
specialized cells called sheath cells.
d. Fusion of two cells is called Karyogamy.

73. Which of the following statements is incorrect? [OS]
a. Morels and truffles are edible delicacies.
b. *Claviceps* is a source of many alkaloids and LSD.
c. Conidia are produced exogenously and asco
endogenously.
d. Yeasts have filamentous bodies with long thre
hyphae.

74. After karyogamy followed by meiosis, spores are pro
exogenously in
a. *Neurospora* b. *Alternaria*
c. *Agaricus* d. *Saccharomyces*

75. Which one of the following is wrong for fungi? (20
a. They are heterotrophic
b. They are both unicellular and multicellular
c. They are eukaryotic
d. All fungi possess a purely cellulosic cell wall

76. One of the major components of cell wall of most fu
(20
a. Chitin b. Peptidoglycan
c. Cellulose d. Hemicellulose

77. Which one of the following matches is correct? [MR*] (2

a.	*Mucor*	Reproduction by Conjugation	Ascomycete
b.	*Agaricus*	Parasitic fungus	Basidiomyce
c.	*Phytophthora*	Aseptate mycelium	Basidiomyce
d.	*Alternaria*	Sexual reproduction absent	Deuteromyce

78. Choose the wrong statements: [MR*] (201
a. *Neurospora* is used in the study of biochemical ge
b. Morels and truffles are poisonous mushrooms
c. Yeast is unicellular and useful in fermentation
d. *Penicillium* is multicellular and produces antibiot

79. The imperfect fungi which are decomposer of litter and help in mineral cycling belong to: *(2015 Re)*
a. Basidiomycetes b. Phycomycetes
c. Ascomycetes d. Deuteromycetes

80. Which one of the following fungi contains hallucinogens? [OS] *(2014)*
a. *Ustilago sp.* b. *Morchella esculenta*
c. *Amanita muscaria* d. *Neurospora sp.*

81. Some hyperthermophilic organisms that grow in highly acidic (pH) habitats belong to two groups: *(2010 Pre)*
a. *Cyanobacteria* and diatoms
b. Protists and mosses
c. Liverworts and yeasts
d. Eubacteria and archaebacteria

82. Which of the following environmental conditions are essential for optimum growth of *Mucor* on a piece of bread? [OS] *(2006)*
A. Temperature about 25°C
B. Temperature about 5°C
C. Relative humidity of about 5%
D. Relative humidity of about 95%
E. A shaded place
F. A brightly illuminated place
Choose the answer from the following options
a. B, C and F only b. A, C and E only
c. A, D and E only d. B, D and E only

83. Adhesive pad of fungi penetrate the host with the help of: [OS] *(2001)*
a. Mechanical pressure and enzymes
b. Hooke and suckers
c. Softening by enzymes
d. Only by mechanical pressure

84. In most of the fungi, the food material is stored in the form of: *(2000)*
a. Starch b. Proteins
c. Glycogen d. Chitin

85. The black rust of wheat in a fungal disease caused by: *(1995)*
a. *Albugo candida* b. *Puccinia graminis tritici*
c. *Melampsora lini* d. *Claviceps purpurea*

86. Cellulose is major component of cell wall of: *(2008)*
a. *Pseudomonas* b. *Saccharomyces*
c. *Pythium* d. *Xanthomonas*

Kingdom Plantae

87. How many organisms in the list given below are autotrophs? *Lactobacillus, Nostoc, Chara, Nitrosomonas, Nitrobacter, Streptomyces, Saccharomyces, Trypanosoma, Porphyra, Wolfia*: [MR*] *(2012 Mains)*
a. Four b. Five
c. Six d. Three

88. Pick up the wrong statement: [MR*] *(2015 Re)*
a. Protista has photosynthetic and heterotrophic modes of nutrition
b. Some fungi are edible
c. Nuclear membrane is present in Monera
d. Cell wall is absent in Animalia

89. Which one of the following living organisms completely lacks a cell wall? *(2014)*
a. Blue - green algae b. Cyanobacteria
c. Sea - fan (*Gorgonia*) d. *Saccharomyces*

Viruses, Viroids, Prions & Lichens

90. Mad cow disease in cattle and Cr Jacob disease in humans are due to infection by _____. *(2022 Re)*
a. Prion b. Bacterium
c. Virus d. Viroid

91. Which of the following is correct about viroids? [MR*] *(2020)*
a. They have free RNA without protein coat.
b. They have DNA with protein coat.
c. They have free DNA without protein coat.
d. They have RNA with protein coat.

92. Which of the following statement is Incorrect? *(2019)*
a. Viroids lack a protein coat.
b. Viruses are obligate parasites.
c. Infective constituent in viruses is the protein coat.
d. Prions consist of abnormally folded proteins.

93. Viroids differ from viruses in having: *(2017-Delhi)*
a. DNA molecules with protein coat
b. DNA molecules without protein coat
c. RNA molecules with protein coat
d. RNA molecules without protein coat

94. Which of the following statements is wrong for viroids? *(2016 - I)*
a. They lack a protein coat
b. They are smaller than viruses
c. They causes infections
d. Their RNA is of high molecular weight

95. Which of the following are most suitable indicators of SO_2 pollution in the environment? [OS] *(2015 Re)*
a. Conifers b. Algae
c. Fungi d. Lichens

96. Select the wrong statements: [MR*] *(2015 Re)*
a. W.M. Stanley showed that viruses could be crystallised
b. The term '*Contagium vivum fluidum*' was coined by M.W. Beijerinck
c. Mosaic disease in tobacco and AIDS in human being are caused by viruses
d. The viroids were discovered by D.J. Ivanowsky

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97. Viruses have: *(2014)*
a. Both DNA and RNA
b. DNA enclosed in a protein coat
c. Prokaryotic nucleus
d. Single chromosome

98. A location with luxuriant growth of lichens on the trees indicates that the: *(2014)*
a. Location is not polluted
b. Trees are very healthy
c. Trees are heavily infested
d. Location is highly polluted

99. Which of the following shows coiled RNA strand and capsomeres? *(2014)*
a. Retrovirus b. Polio virus
c. Tobacco mosaic virus d. Measles virus

100. Which one single organism or the pair of organisms is correctly assigned to its or their named taxonomic group? [MR*] *(2012 Pre)*
a. *Nostoc* and *Anabaena* are examples of Protista
b. *Paramecium* and *Plasmodium* belong to the same kingdom as that of *Penicillium*
c. Lichen is a composite organism formed from the symbiotic association of an algae and a protozoan
d. Yeast used in making bread and beer is a fungus

101. Which statement is wrong for virus? *(2012 Pre)*
a. Antibiotics have no effect on them
b. All are parasites
c. All of them have helical symmetry
d. They have ability to synthesize nucleic acids and proteins

102. Proteinaceous infectious particles causing diseases are: *(2010 Pre)*
a. Prions b. Viroids
c. Viruses d. *Chlamydia*

103. T.O. Diener discovered: *(2009)*
a. Bacteriophage b. Infectious protein
c. Free infectious DNA d. Free infectious RNA

104. Which of the following is used as an atmospheric pollution indicator? *(2007)*
a. Lepidoptera b. Lichens
c. Lycopersicon d. Lycopodium

105. There exists a close relationship between alga and fungus within a lichen. The fungus: *(2005)*
a. Provides protection, anchorage and absorption for the algae
b. Provides food for alga
c. Releases oxygen for the alga
d. Fixes the atmospheric nitrogen for the alga

106. Carbohydrates, the most abundant biomolecules, on earth are produced by: *(2005)*
a. Some bacteria, algae and green plants
b. Fungi, algae and green plants
c. All bacteria, fungi and algae
d. Viruses, fungi and bacteria

107. Viruses that infect bacteria, multiply and cause their lysis called: [OS] *(2...*
a. Lipolytic
b. Lytic
c. Lysogenic
d. Lysozymes

108. Which of the following statements is not true for retrovir... [OS] *(2...*
a. Retroviruses carry gene for RNA-dependent D... polymerase
b. The genetic material in mature retroviruses is RNA
c. Retroviruses are causative agents for certain kinds ... cancer in man
d. DNA is not present at any stage in the life cycle ... retroviruses

109. Lichens are well known combination of an alga and a fu... where fungus has: *(20...*
a. An epiphytic relationship with the alga
b. A parasitic relationship with the alga
c. A symbiotic relationship with the alga
d. A saprophytic relationship with the alga

110. Viruses are no more "alive" than isolated chromosom... because: *(20...*
a. They require both RNA and DNA
b. They both need food molecules
c. They both require oxygen for respiration
d. Both require the environment of a cell to replicate

111. Tobacco mosaic virus is a tubular filament of size: [OS] *(20...*
a. 300 × 10 nm b. 300 × 5 nm
c. 300 × 20 nm d. 700 × 30 nm

112. Which one of the following statements about viruses ... correct? *(20...*
a. Viruses possess their own metabolic system
b. All viruses contain both RNA and DNA
c. Viruses are obligate parasites
d. Nucleic acid of viruses is known as capsid

113. Cauliflower mosaic virus contains: [OS] *(20...*
a. ss RNA b. ds RNA
c. ds DNA d. ss DNA

114. Virus are living because: *(20...*
a. They multiply in host cells
b. Carry anaerobic respiration
c. Carry metabolic activity
d. Cause infection

115. Which disease of man is similar with cattle's, bovi... spongiform encephalopathy? [OS] *(20...*
a. Encephalitis
b. Jacob-creutzfeldt disease
c. Spongiocitis of cerebrum
d. Spondylitis

116. Lichens can be used as: *(1999)*
a. Bio-indicator for water and air pollution
b. Initial vegetation for waste lands
c. Source of wood
d. To check the air pollution

117. Indicator of water pollution: [OS] *(1998)*
a. *E. Coli* b. *Chlorella*
c. *Beggiatoa* d. *Ulothrix*

118. Viruses posses: *(1997)*
a. Ribosomes to synthesize protein
b. Organelle for its vital mechanism
c. Either DNA or RNA
d. None of these

119. Most of the lichens consist of: *(1997)*
a. Green algae and Ascomycetes
b. Brown algae and higher plant
c. Blue green algae and Basidiomycetes
d. Red algae and Ascomycetes

120. What is the genetic material in *Influenza virus*? [OS] *(1996)*
a. Double helical DNA b. RNA
c. Single helix DNA d. None of these

121. Which one of the following statement about lichens is wrong? *(1996)*
a. These grow very rapidly (2 cm per day)
b. They show fungal and algal symbiotic relationships
c. Some of its species are eaten by reindeers
d. These are pollution indicators

122. Tobacco mosaic virus (TMV) genes are: *(1994)*
a. Single stranded RNA b. Double stranded DNA
c. Proteinaceous d. Double stranded RNA

123. Organisms which are indicator of SO_2 pollution of air: [MR*] *(1992)*
a. Mosses b. Lichens
c. Mushrooms d. Puffball's

124. Lichens indicate SO_2 pollution because they: *(1989)*
a. Show association between algae and fungi
b. Grow faster than others
c. Are sensitive to SO_2
d. Flourish in SO_2 rich environment

125. Rickettsia form a group under: *(1994)*
a. Viruses
b. Bacteria
c. Fungi
d. A category between viruses and bacteria

Answer Key

1. (b)	2. (a)	3. (d)	4. (b)	5. (b)	6. (b)	7. (b)	8. (a)	9. (b)	10. (a)
11. (c)	12. (d)	13. (c)	14. (c)	15. (c)	16. (a)	17. (b)	18. (b)	19. (a)	20. (a)
21. (a)	22. (d)	23. (b)	24. (c)	25. (c)	26. (c)	27. (d)	28. (c)	29. (d)	30. (c)
31. (a)	32. (b)	33. (a)	34. (d)	35. (b)	36. (b)	37. (a)	38. (b)	39. (b)	40. (d)
41. (a)	42. (a)	43. (b)	44. (d)	45. (a)	46. (b)	47. (c)	48. (a)	49. (a)	50. (a)
51. (b)	52. (b)	53. (c)	54. (b)	55. (d)	56. (c)	57. (c)	58. (d)	59. (a)	60. (b)
61. (c)	62. (d)	63. (c)	64. (a)	65. (b)	66. (b)	67. (a)	68. (a)	69. (d)	70. (c)
71. (b)	72. (a)	73. (d)	74. (c)	75. (d)	76. (a)	77. (d)	78. (b)	79. (d)	80. (c)
81. (d)	82. (c)	83. (a)	84. (c)	85. (b)	86. (c)	87. (c)	88. (c)	89. (c)	90. (a)
91. (a)	92. (c)	93. (d)	94. (d)	95. (d)	96. (d)	97. (b)	98. (a)	99. (c)	100. (d)
101. (c)	102. (a)	103. (d)	104. (b)	105. (a)	106. (a)	107. (b)	108. (d)	109. (c)	110. (d)
111. (c)	112. (c)	113. (c)	114. (a)	115. (b)	116. (d)	117. (a)	118. (c)	119. (a)	120. (b)
121. (a)	122. (a)	123. (b)	124. (c)	125. (b)					

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Explanations

1. **(b)** Main criteria for classification used by R.H. Whittakar includes cell structure, body organisation, mode of nutrition, reproduction and phylogenetic relationship.

2. **(a)** *Chlamydomonas* and *Chlorella* are green-algae that belong to kingdom Plantae, division Algae and class Chlorophyceae. In five-kingdom classification, they were placed in kingdom Protista.

3. **(d)** According to five-kingdom classification, all prokaryotic cells have been classified under kingdom Monera.

4. **(b)** Mode of nutrition is one of the main criteria for classification used by R.H. Whittaker. Other criteria include cells structure, body organisation, reproduction and phylogenetic relationships.

5. **(b)** Cyanobacteria (blue-green algae) being unicellular and prokaryotic belong to kingdom Monera of five-kingdom classification given by R. H. Whittaker.

6. **(b)** Modern day classification is based on not only the morphological but also physiological, anatomical, reproductive and phylogenetic similarities.

7. **(b)** Only statement (b) is correct and rest other statements are incorrect. Mycoplasma is a bacterium that lacks cell wall. Mycoplasma have DNA and ribosomes. Cyanobacteria are photosynthetic bacteria classified under kingdom Monera. Bacteria can be photosynthetic autotrophic or chemosynthetic autotrophic. The vast majority of bacteria are heterotrophs, i.e., they depend on other organisms or on dead organic matter for food. Slime moulds are saprophytic organisms classified under Kingdom Protista.

8. **(a)** Cyanobacteria (also referred to as blue-green algae) have chlorophyll *a* similar to green plants and are photosynthetic autotrophs. Some of these organisms can fix atmospheric nitrogen in specialised cells called heterocysts, e.g., *Nostoc* and *Anabaena*

9. **(b)** Green sulphur bacteria perform anoxygenic photosynthesis. They mainly use sulfide ions as electron donors.

10. **(a)** Archaebacteria are special since they live in some of the most harsh habitats such as extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens).

11. **(c)** Mycoplasmas are organisms without a cell wall. They are the smallest living cells known. They can survive without oxygen. Many are pathogenic in animals and plants.

12. **(d)** Methanogens belong to Archaebacteria and are present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals.

13. **(c)** Eubacteria are also known as true bacteria. They are characterised by the presence of a rigid cell wall, and if motile, a flagellum.

14. **(c)** Methanogens are present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals.

15. **(c)** *Vaucheria* and *Volvox* are eukaryotes (Plant kingdom) while *Mucor* is a fungi (phycomycetes) and a eukaryote. *Anabaena* is a prokaryote. Prokaryotes lack nucleus.

16. **(a)** Some of the methanogens (archaebacteria) live as symbionts (e.g., *Methanobacterium*) inside rumen of cows, buffaloes and helpful to the ruminants in fermentation of cellulose.

17. **(b)** Mycoplasma are organisms that completely lack cell wall. They are the smallest living cells known and can survive without oxygen.

18. **(b)** One of the most distinctive features of the *Archaea* is the nature of their membrane lipids. They differ from both *Bacteria* and *Eukarya* in having branched chain hydrocarbons attached to glycerol by ether links rather than fatty acids connected by ester links. Some archaeal membranes are lipid monolayers instead of bilayers.

19. **(a)** Nuclear membrane is absent in *Nostoc* (prokaryote) while remaining three are eukaryotes.

20. **(a)** The Cyanobacteria are also referred to as blue-green algae (BGA). It belongs to Eubacteria.

21. **(a)** Heterotrophic bacteria are the most abundant in nature. The majority are important decomposers. Many of them have a significant impact on human affairs. They are helpful in making curd from milk, production of antibiotics, fixing nitrogen in legume roots.

22. **(d)** Monerans have maximum nutritional diversity as some of them are autotrophs, heterotrophs, saprophytes, parasites, symbiotic (*Anabaena*), commensalism & mutualism.

23. **(b)** Bacterial membranes are similar to eukaryotic membranes in that many of their amphipathic lipids are phospholipids.

24. **(c)** Methanogens are archaebacteria, found in marshy areas. They are present in the gut of several ruminant animals.

25. **(c)** *Chlorobium* (Green sulphur bacteria), *Rhodospirillum* (purple non-sulphur bacteria), *Chromatium* perform anoxygenic photosynthesis.

26. **(c)** Protein of Archaebacteria closely resembles the eukaryotic cell in the mechanism of protein synthesis, structural proteins and RNA compliments of the ribosomes. *Thermococcus*, *Methanococcus* and *Methanobacterium* are archaebacteria.

27. **(d)** It is primitive prokaryote. Its ribosomal ribonucleotide in 16S rRNA are different from other organisms.

28. **(c)** They are insensitive to Penicillin due to absence of cell wall while their growth is inhibited by the tetracycline.

29. **(d)** Bacterium *Clostridium botulinum* is obligate anaerobe means they cannot survive in the presence of oxygen.

30. **(c)** Barophilic prokaryotes are organisms that survives in a high-pressure environment. They can grow and multiply in very deep marine sediments.

31. **(a)** Transduction is one of the methods of introduction of foreign gene into a cell. In this method, virus is used to transfer genes from one cell/bacterium to another cell/ bacterium.

32. **(b)** Autotrophs are organisms who produces their own food. They can be photoautotrophs or chemoautotrophs. Organisms who synthesise their own food by deriving energy from sunlight are called photoautotroph, whereas organisms that derive energy from inorganic compounds to synthesise food are called chemoautotrophs.

33. **(a)** Cyanobacteria are capable of fixing atmospheric N_2 in presence of sunlight. Nitrogenase, enzyme complex that is responsible for fixing N_2 in cyanobacteria, is sensitive to oxygen & require a near to anoxic environment. These bacteria can produce oxygen through photosynthesis and thus called oxygenic.

34. **(d)** Archaebacteria are oldest bacteria that live in some of the most harsh habitats. They have a different cell wall structure than other bacteria and this feature is responsible for their survival in extreme conditions.

35. **(b)** Photolithotrophs utilise light energy, with the inorganic compound serving as the ultimate electron donor, e.g, higher plants.

36. **(b)** Thermophiles live in a habitat where temperature exceeds 100°C and therefore these bacteria can survive in hot springs.

37. **(a)** Bacteriophage is a virus that infect bacteria. During this infection, these viruses transfer the genetic material from one bacterium to another, a process called transduction.

38. **(b)** *E. coli* has genetic material in the form of DNA. Two strands of DNA are helically bound to each other and form a complete DNA molecule.

39. **(b)** Blue-green algae are unicellular organisms classified in kingdom Monera. Individuals belongs to Monera have prokaryotic cells & thus they are called prokaryotes.

40. **(d)** *Azotobacter* & *B. polymyxa* are N_2-fixing bacteria. They are free-living microbes and thus do not exhibit symbiosis.

41. **(a)** During conjugation, conjugative pili allow for DNA transfer between bacteria. They are sometimes called 'sex pili' in analogy to sexual reproduction, because they allow for the exchange of genes via the formation of mating pairs.

42. **(a)** Bacteria have prokaryotic cell architecture. Their genetic material (DNA) is not bounded by any membrane and remains free in the cell. Most bacteria possess circular DNA.

43. **(b)** Caudovirales, also known as tailed bacteriophages, are non-motile.

44. **(d)** *Pseudomonas* is a Gram-negative bacteria that live in the soil and decaying matter.

45. **(a)** Many bacteria fix the atmospheric nitrogen present in soil and are called N_2 fixing bacteria. e.g., *Nostoc*, *Anabaena*, *Pseudomonas*, etc.

46. **(b)** Phage vectors are cloning vectors formed of bacteriophage, a virus that infects bacteria. Genes that are needed to transfer into bacteria, are integrated in phage DNA and using these transformed bacteriophages, the bacteria are infected & transducted with gene of interest.

47. **(c)** Histones are found in eukaryotes to form coiling unit nucleosome, whereas, in prokaryotes some basic proteins assist in coiling of their genetic material. Bacterial DNA is double stranded and is present as a single molecule.

48. **(a)** *E. coli* is used as model organism for prokaryotes. Bacteria *E. coli* can be easily grown in laboratory and divide faster. Thus, it is very easy for scientist to culture this organism and use for biological researches.

49. **(a)** Bacteria exchange their genetic material through conjugation but they lack alternation of generation as there is no syngamy or meiosis in bacteria.

50. **(a)** Chemosynthetic bacteria use inorganic molecules as a source of energy & convert them into organic substances. They do not perform photosynthesis like plants & thus do not depend directly indirectly on sun for energy needs.

51. **(b)** Monera includes all bacteria. *Escherichia* is a genus of kingdom Monera & is a rod-shaped, facultative anaerobic bacteria. *Gelidium* & *Spirogyra* are algae, belongs to kingdom Plantae. Amoeba is a protozoan classified under kingdom Protista.

52. **(b)** Blue-green algae such as *Oscillatoria terebriformis* found in hot springs, at about 70°C. The temperature tolerance is due to the presence of hemopolar bonds in their proteins.

53. **(c)** Protozoans like specozoa have no movement and they do not possess pseudopods, flagella or cilia.

54. **(b)** Diatoms are the most common phytoplankton in the ocean. They utilise inorganic nutrients to form proteins, fats and provide food for various sea creatures. Diatoms are the chief 'producers' in the oceans.

55. **(d)** Ciliates contain two types of nuclei - somatic macronucleus and germline micronucleus.

56. **(c)** The walls of diatoms are embedded with silica and thus the walls are indestructible.

57. **(c)** All single-celled eukaryotes are placed under kingdom Protista. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom Protista.

58. **(d)** Chrysophytes: Group under Protista includes diatoms and golden algae (desmids). They are found in fresh as well as marine environments. In diatoms, the cell wall form two thin overlapping shells which fit together like a soap box.

59. **(a)** *Physarum* is a slime mould. *Rhizopus* is fungus. *Anabaena* and *Thiobacillus* are monerans.

60. **(b)** They are all unicellular eukaryotes (Protista).

61. **(c)** Under suitable conditions, slime moulds form an aggregation called plasmodium which may grow over several feets. During unfavorable conditions, plasmodium differentiates and forms fruiting bodies bearing true spores.

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62. **(d)** During sexual reproduction, several diatoms produce specialised cells called auxospores. Hormocyst are the specialised structures found in some cyanobacteria which helps in reproduction.

63. **(c)** *Paramoecium* has 2 kinds of nuclei - macronucleus (a large ellipsoidal nucleus) and micronucleus (small nucleus). Both contain the full hereditary material. Micronucleus functions in sexual reproduction. The macronucleus is director of the cell's activities.

64. **(a)** In marine water, water in medium is more concentrated than inside environment of fresh water protozoan cell. Such condition will result in disappearance of contractile vacuole.

65. **(b)** The diatoms found in diatomaceous earth are made up of silica, a common component of the earth's natural rock, sands, and clays. The silica reacts commonly with oxygen and water to form silicon dioxide. Most diatomaceous earth is made of silicon dioxide.

66. **(b)** Protistans include unicellular eukaryotes. Being eukaryotic, they contain true nucleus, i.e., genetic material is membrane-bound & exist as a separate entity in cytoplasm of the cell.

67. **(a)** *Euglena* have both plant and animal characteristics. It is an unicellular protistan. Like plants, it uses chloroplast to perform photosynthesis and produce sugars and like animals they are heterotroph and consume food by phagocytosis.

68. **(a)** Contractile vacuole in protozoans (*Amoeba, Paramoecium*) expels out excess of water by contracting itself and thus helps in osmoregulation of the cell.

69. **(d)** Female *Anopheles* mosquitoes are definitive hosts harbouring sexual reproduction stage of *Plasmodium*. 3 stages of life cycle of *Anopheles* mosquito - egg, larva and pupa - are aquatic. Therefore, if all ponds and puddles will be destroyed then population of *Anopheles* will be affected resulting in incompletion of life cycle of *Plasmodium*.

70. **(c)** Charles Louis Alphonse Laveran, a french army surgeon, was the first to notice *Plasmodium* in RBCs of human beings.

71. **(b)** *Trypanosoma* is unicellular parasitic flagellate protozoan and thus belongs to Zooflagellata.

72. **(a)** Plasmogamy – It is the fusion of the two motile or non-motile gametes.

Autotrophs – Organisms that depend on living plants.

Heterocyst – Specialised cells in cyanobacteria that helps in fixing atmospheric nitrogen.

Karyogamy – Fusion of two nuclei.

73. **(d)** Yeast is an unicellular sac fungus. It lacks filamentous structure or hyphae.

74. **(c)** In *Agaricus*, the basidiospores (or meiotic spores) are produced on basidium exogenously or externally.

75. **(d)** The cell walls of fungi are composed of chitin and polysaccharides. The green plants have a cellulosic cell wall.

76. **(a)** The cell walls of fungi are composed of chitin (*N*-acetyl glucosamine) and polysaccharides.

77. **(d)** *Mucor* – Phycomycetes

Agaricus – Non-parasitic fungus

Phytophthora – Oomycete

Alternaria – Absence of sexual reproduction (Deuteromycetes)

78. **(b)** Many members of Ascomycetes like morels and truf... are edible and are considered delicacies.

79. **(d)** Deuteromycetes is an artificial class of fungi wh... includes all those fungi in which sexual stage is not kno... They are commonly known as imperfect fungi. Se... members are saprophytes or parasites while a large num... of them are decomposers of litter and help in mineral cycl...

80. **(c)** *Amanita muscaria* has hallucinogenic properties.

81. **(d)** Special cell wall structure of archaebacteria and eubac... makes them survive under extreme conditions.

82. **(c)** *Mucor* grows well in moderate temperature, high relat... humidity and shady place.

83. **(a)** Through adhesive pads, the fungus can exert intrus... force necessary to penetrate host and certain enzyme prese... in pads softens the surface of host, thereby, facilitates ... attachment to host.

84. **(c)** Glycogen is the chief storage form in most of the fun...

85. **(b)** Many fungi depends on living plants and animals ... parasites. In wheat, a disease of black rust is caused b... fungus *Puccinia graminis tritici*.

86. **(c)** *Pythium* belongs to group oomycetes. Hyphal wa... contain chitin and cellulose in oomycetes.

87. **(c)** Photosynthetic autotrophs are *Nostoc*, *Porphyra*, *Wolf... Chara*; *Nitrosomonas & Nitrobacter* are chemosynthe... autotrophs.

88. **(c)** Animal's cells do not have cell wall.

Agaricus (mushroom) is an edible fungi.

Prokaryotic cells lack nuclear membrane.

Protists have photosynthetic, holozoic, saprotroph... parasitic, etc. modes of nutrition.

89. **(c)** Sea fan (*Gorgonia*) belongs to kingdom Animalia, as ... is an animal so it lacks a cell wall. BGA (Blue-green alga... or cyanobacteria and *Saccharomyces* have cell walls.

90. **(a)** Mad cow disease in cattle and Cr-Jakob disease in humans are caused by prions, which are proteins that have misfolded...

91. **(a)** Viroids are infectious agents which are smaller tha... viruses and cause potato spindle tuber disease. They ar... made up of circular single stranded RNA and a lack protei... coat.

92. **(c)** Infective constituent in viruses is the genetic materi... either DNA or RNA, not protein.

93. **(d)** Viroids are sub-viral agents as infectious RNA particle... without a protein coat.

94. **(d)** In 1971, T.O. Diener discovered a new infectious agen... that was smaller than viruses and caused potato spindle tube... disease. It was found to be a free RNA; it lacked the protei... coat that is found in viruses, hence the name viroid. The RNA... of the viroid is of low molecular weight.

95. **(d)** Lichens serve as indicator of air pollution, as they are very sensitive to air pollution, especially SO_2 pollution.

96. **(d)** In 1971, T.O Diener discovered a new infectious agent namely viroid which is smaller than virus.

97. **(b)** Genetic material of a virus is enclosed by the protein coat.

98. **(a)** Lichens are good air pollution indicator – they do not grow in polluted areas.

99. **(c)** Tobacco mosaic virus shows coiled RNA strand and capsomeres.

100. **(d)** The dough, which is used for making bread, is fermented using baker's yeast *(Saccharomyces cerevisiae)*.

Nostoc and *Anabaena* are examples of cyanobacteria.

Lichen is a composite organism formed from the symbiotic association of an alga and a fungus.

Paramoecium belongs to ciliated protozoa.

Plasmodium belongs to sporozoans. *Penicillium* belongs to Ascomycetes.

101. **(c)** Viruses are of different symmetry, not all viruses have helical symmetry.

102. **(a)** A prion is an infectious agent composed entirely of protein.

103. **(d)** T.O. Diener discovered viroids in 1971. Genetic material of viroids is RNA that is not enclosed by proteinaceous envelope.

104. **(b)** Lichens are very good atmospheric pollution indicators. They do not grow in areas that are polluted, as they are sensitive (especially phycobiont) to oxides of nitrogen and sulphur, hence unable to synthesise organic food and do not grow well.

105. **(a)** Lichen → Close association of an alga and a fungus. Fungus transports water and minerals to the algal partner while algal partner provides food.

106. **(a)** Carbohydrates (example cellulose, starch, glycogen, glucose, fructose, etc.) are the most abundant biomolecules on earth. The carbohydrates are produced by the reduction of atmospheric carbon dioxide with the help of light energy in the process of photosynthesis. Common photosynthetic organisms are cyanobacteria, algae and green plants.

107. **(b)** There are two cycles of reproduction in viruses:

1. Lysogenic cycle, in which nucleic acid of viruses are integrated into host's genome & replicated.
2. Lytic cycle, where virus infect bacteria, multiply and destruct the cell & its membrane.

Lipolysis: Breakdown of fats/lipids.

Lysozymes: Enzymes that cause lysis of bacterial cell.

108. **(d)** In retroviruses, genetic material RNA is converted into DNA by enzyme reverse transcriptase. Thus, retroviruses have DNA as an intermediate.

109. **(c)** In lichens, fungi and algae both are benefitted and live together as symbionts. Algae, being photosynthesiser, provide constant supply of food and fungus absorb water and minerals for algae.

110. **(d)** Viruses, like chromosomes, require the machinery of cell to replicate & synthesise proteins as they lack their own environment of replication.

111. **(c)** TMV are ~ 300 nm in length & ~ 18 nm in diameter.

112. **(c)** Viruses has either DNA or RNA as their genetic material and a protein coat called capsid. They lack their own metabolic system & thus depend on host cells for their replication. Virus infect the host cells replicate through it and therefore called as obligate parasites.

113. **(c)** Genetic material of cauliflower mosaic virus is a double stranded DNA molecule.

114. **(a)** Viruses have the ability to replicate and make its own copies using host cell machinery. Due to this means of reproduction, they can be called living.

115. **(b)** The common term for bovine spongiform encephalopathy is mad cow disease, which is a progressive neurological disorder of cattle. It is similar to Creutzfeldt-Jakob disease.

116. **(d)** Lichens are useful bioindicators for air pollution, especially SO_2 pollution, since they derive water and essential nutrients mainly from atmosphere rather than from the soil.

117. **(a)** *E. coli* is a member of the faecal coliform group and is a more specific indicator of faecal pollution in water. *E. coli* indicates the bacteriological quality of water.

118. **(c)** Viruses contain enfolded genetic material inside a protein coat. That genetic material can be DNA or RNA, depending on virus. Ribosomes & other organelles are absent, that's why, viral protein synthesis takes place inside the host cell after infection.

119. **(a)** Mostly the lichens are formed of green algae & Ascomycetes.

120. **(b)** Influenza virus contains RNA as genetic material.

121. **(a)** Lichens grow very slowly – some less than 1 mm per year.

122. **(a)** ssRNA is present as a genetic material in Tobacco mosaic virus (TMV). TMV cause disease in plants of tobacco. In general, virus that infect plants have single stranded RNA as in TMV.

123. **(b)** Lichens are very good pollution indicators as they do not grow in polluted areas. They are useful bioindicators for SO_2 pollution since they derive their water and essential nutrient mainly from atmosphere.

124. **(c)** Lichens are sensitive to SO_2 present in atmosphere, therefore they serve as a bioindicator of air pollution. In polluted areas, lichens do not grow.

125. **(b)** *Rickettsia* is placed in the family Rickettsiaceae of -proteobacteria.

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CHAPTER 3

plant Kingdom

Introduction

1. Phylogenetic system of classification is based on: *(2009)*
   a. Morphological features
   b. Chemical constituents
   c. Evolutionary relationships
   d. Floral characters
2. Phenetic classification of organisms is based on: *(2004, 2003)*
   a. The ancestral lineage of existing organisms
   b. Dendrogram based on DNA characteristics
   c. Sexual characteristics
   d. Observable characteristics of existing organisms
3. Phylogenetic classification is one which is based on: *(1994)*
   a. Overall similarities
   b. Utilitarian system
   c. Habits of plants
   d. Common evolutionary descent
4. System of classification used by Linnaeus are: *(1989)*
   a. Natural system b. Artificial system
   c. Asexual system d. Phylogenetic system
5. Artificial system of classification was first used by: *(1989)*
   a. Linnaeus b. de Candolle
   c. Pliny the Elder d. Bentham and Hooker
6. Classification given by Bentham and Hooker is: *(1988)*
   a. Artificial b. Natural
   c. Phylogenetic d. Numerical

Algae

7. Which classes of algae possess pigment fucoxanthin and pigment phycoerythrin, respectively? [MR*] *(2023-Manipur)*
   a. Phaeophyceae and Chlorophyceae
   b. Phaeophyceae and Rhodophyceae
   c. Chlorophyceae and Rhodophyceae
   d. Rhodophyceae and Phaeophyceae
8. Read the following statements and identify the chara... related to the alga shown in the diagram *(2021)*

   A. It is a member of Chlorophyceae
   B. Food is stored in the form of starch
   C. It is a monoecious plant showing oogonium a... antheridium
   D. Food is stored in the form of laminarin or mannitol
   E. It shows dominance of pigments Chlorophyll a, c a... Fucoxanthin
   Choose the correct answer from the options given below:
   a. (C), (D) and (E) only b. (A) and (B) only
   c. (A), (B) and (C) only d. (A), (C) and (D) only
9. Which of the following is incorrectly matched? *(202...*
   a. *Volvox* - Starch b. *Ectocarpus* - Fucoxanthin
   c. *Ulothrix* - Mannitol d. *Porphyra* - Floridean Sta...
10. Hydrocolloid carrageen is obtained from: *(202...*
    a. Phaeophyceae only
    b. Chlorophyceae and Phaeophyceae
    c. Phaeophyceae and Rhodophyceae
    d. Rhodophyceae only
11. Which of the following algae produce Carrageen? *(202...*
    a. Brown algae b. Red algae
    c. Blue-green algae d. Green algae
12. Which of the following algae contains mannitol as reser... food material? *(202...*
    a. *Gracilaria* b. *Volvox*
    c. *Ulothrix* d. *Ectocarpus*
13. Which of the following pairs is of unicellular algae? [MR*] *(20...*
    a. *Gelidium* and *Gracilaria* b. *Anabaena* and *Volvox*
    c. *Chlorella* and *Spirulina* d. *Laminaria* and *Sargassum*
14. Floridean starch has structure similar to: [MR*] *(2020)*
    a. Amylopectin and glycogen
    b. Mannitol and algin
    c. Laminarin and cellulose
    d. Starch and cellulose
15. Phycoerythrin is the major pigment in: *(2020-Covid)*
    a. Blue green algae b. Green algae
    c. Brown algae d. Red algae
16. An example of colonial alga is *(2017-Delhi)*
    a. *Chlorella* b. *Volvox*
    c. *Ulothrix* d. *Spirogyra*
17. Which one of the following statements is wrong? [MR*] *(2016 - II)*
    a. Agar-agar is obtained from *Gelidium* and *Gracilaria*.
    b. *Laminaria* and *Sargassum* are used as food.
    c. Algae increase the level of dissolved oxygen in the immediate environment.
    d. Algin is obtained from red algae, and carrageen from brown algae.
18. Male gametes are flagellated in: *(2015)*
    a. *Ectocarpus* b. *Spirogyra*
    c. *Polysiphonia* d. *Anabaena*
19. Isogamous condition with non-flagellated gametes is found in: *(2013)*
    a. *Fucus* b. *Chlamydomonas*
    c. *Spirogyra* d. *Volvox*
20. Select the wrong statement: [MR*] *(2013)*
    a. *Chlamydomonas* exhibits both isogamy and anisogamy and *Fucus* shows oogamy
    b. Isogametes are similar in structure, function and behaviour
    c. Anisogametes differ either in structure, function or behaviour
    d. In oogamous reproduction, female gamete is smaller and motile, while male gamete is larger and non motile
21. Sexual reproduction is absent in: [OS] *(2010 Pre)*
    a. Xanthophyta b. Cyanophyta
    c. Chlorophyta d. Rhodophyta
22. Mannitol is storage food in: *(2009)*
    a. *Gracilaria* b. *Chara*
    c. *Porphyra* d. *Fucus*
23. In oogamy, fertilisation involves: *(2004)*
    a. A large non-motile female gamete and a small motile male gamete
    b. A large non-motile female gamete and a small non-motile male gamete
    c. A large motile female gamete and a small non-motile male gamete
    d. A small non-motile female gamete and a large motile male gamete
24. A student observed an algae with chlorophyll 'a', 'd' and phycoerythrin. It should belong to: [MR*] *(2000)*
    a. Phaeophyta b. Rhodophyta
    c. Chlorophyta d. Bacillariophyta
25. True statement for *Ulothrix*: *(1998)*
    a. Filamentous thallus and flagellated reproductive structures
    b. Branched thallus
    c. Flagellated cells absent
    d. None of the above
26. An alga, very rich in protein, is: [MR*] *(1997)*
    a. *Chlorella* b. *Nostoc*
    c. *Spirogyra* d. *Ulothrix*
27. *Ulothrix* filaments produce: *(1997)*
    a. Heterogametes b. Basidiospores
    c. Isogametes d. Anisogametes
28. Brown algae is characterised by the presence of: *(1997)*
    a. Fucoxanthin b. Haematochrome
    c. Phycocyanin d. Phycoerythrin
29. The pyrenoids are made up of: *(1995)*
    a. Proteinaceous centre and starchy sheath
    b. Core of nucleic acid surrounded by protein sheath
    c. Core of protein surrounded by fatty sheath
    d. Core of starch surrounded by sheath of protein
30. The sexual reproduction is absent in: *(1995)*
    a. *Spirogyra* b. *Nostoc*
    c. *Ulothrix* d. *Volvox*
31. In chlorophyceae, the mode of sexual reproduction is: *(1994)*
    a. Isogamy b. Anisogamy
    c. Oogamy d. All of these
32. Pyrenoids are the centres for formation of: *(1993)*
    a. *Porphyra* b. Enzymes
    c. Fat d. Starch
33. Chloroplast of *Chlamydomonas* is: *(1993)*
    a. Stellate b. Cup-shaped
    c. Collar-shaped d. Spiral
34. In *Ulothrix*/*Spirogyra*, reduction division (meiosis) occurs at the time of: *(1993)*
    a. Gamete formation b. Zoospore formation
    c. Zygospore germination d. Vegetative reproduction
35. A plant in which sporophytic generation is represented by zygote is: *(1992)*
    a. *Pinus* b. *Selaginella*
    c. *Chlamydomonas* d. *Dryopteris*
36. The common mode of sexual reproduction in *Chlamydomonas* is: *(1991)*
    a. Isogamous b. Anisogamous
    c. Oogamous d. Hologamous
37. The product of conjugation in *Spirogyra* or fertilization of *Chlamydomonas* is: [OS] *(1991)*
    a. Zygospore b. Zoospore
    c. Oospore d. Carpospore
38. Sexual reproduction involving fusion of two cells in *Chlamydomonas* is: *(1988)*
    a. Isogamy b. Homogamy
    c. Somatogamy d. Hologamy

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Bryophytes

39. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R: [MR*] *(2023)*

Assertion A: The first stage of gametophyte in the life cycle of moss is protonema stage.

Reason R: Protonema develops directly from spores produced in capsule.

In the light of the above statements, choose the most appropriate answer from the options given below:

a. A is not correct but R is correct.
b. Both A and R are correct and R is the correct explanation of A.
c. Both A and R are correct but R is NOT the correct explanation of A.
d. A is correct but R is not correct.

40. Gemmae are present in: *(2021)*

a. Pteridophytes b. Some Gymnosperms
c. Some Liverworts d. Mosses

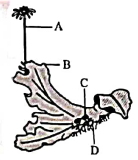
41. Which one is wrongly matched? [MR*] *(2018)*

a. Uniflagellate gametes - *Polysiphonia*
b. Biflagellate zoospores - Brown algae
c. Gemma cups - *Marchantia*
d. Unicellular organism - *Chlorella*

42. Which one of the following is common to multicellular fungi, filamentous algae and protonema of mosses? *(2012 Pre)*

a. Multiplication by fragmentation
b. Diplontic life cycle
c. Members of kingdom Plantae
d. Mode of Nutrition

43. Examine the figure given below and select the right option giving all the four parts (A, B, C, D) correctly identified: *(2011 Mains)*



	A	B	C	D
a.	Seta	Sporophyte	Protonema	Rhizoids
b.	Antheridiophore	Male thallus	Globule	Roots
c.	Archegoniophore	Female thallus	Gemma cup	Rhizoids
d.	Archegoniophore	Female thallus	Bud	Foot

44. Spore dissemination in some liverworts is aided by: [OS]

a. Peristone b. Elaters
c. Calyptra d. Indusium

45. Moss peat is used as a packing material for sending flo... and live plants to distant places because:

a. It serves as disinfectant b. It is hygroscopic
c. It is easily available d. It reduces transpiration

46. In a moss, the sporophyte:

a. Manufactures food for itself as well as for the gametop...
b. Arises from a spore produced from gametophyte
c. Is partially parasitic on the gametophyte
d. Produces gametes that give rise to gametophyte.

47. Sexual reproduction in *Spirogyra* is an advanced fea... because it shows:

a. Different size of motile sex organs
b. Same size of motile sex organs
c. Morphologically different sex organs
d. Physiologically differentiated sex organs

48. Which of the following statement is true for bryophy... [MR*]

a. Along with water absorption roots also provide anchora... to plants
b. Sporophyte is dominant
c. Gametophyte is dominant and sporophyte is mo... parasitic
d. Gametophyte is parasitic

49. *Funaria* male gametes are:

a. Polyflagellate b. Monoflagellate
c. Biflagellate d. Tetraflagellate

50. Water is essential for bryophyta:

a. For fertilisation and homosporous nature
b. Water should be filled in archegonium for fertilisation
c. Water is necessary for movement of sperm
d. For dissemination of spores

51. Bryophytes can be separated from algae because the...

a. Possess archegonia b. Contain chloroplast
c. Are thalloid forms d. Have no conducting tissue

52. Multicellular branched rhizoids and leafy gametophytes a... the characteristics of:

a. Some bryophytes b. Pteridophytes
c. All bryophytes d. Gymnosperms

53. Which of the following plant kingdom is called 'amphibians'...

a. Pteridophyta b. Thallophyta
c. Tracheophyta d. Bryophyta

54. Elater mechanism for spore dispersal is exhibited by: [OS]

a. Liverworts b. *Marchantia*
c. *Riccia* d. *Funaria*

55. The plant body of moss (*Funaria*) is: *(1995)*

a. Completely sporophyte
b. Predominantly gametophyte with sporophyte
c. Completely gametophyte
d. Predominantly sporophyte with gametophyte

56. In bryophytes: *(1994)*

a. Both generations are independent
b. Gametophytes are dependent upon sporophytes
c. Sporophytes complete their life cycle
d. Saprophytes are dependent upon gametophytes

57. Protonema occurs in the life cycle of: *(1993, 1990)*

a. *Riccia* b. *Funaria*
c. *Anthoceros* d. *Spirogyra*

58. The plant group that produces spores and embryo but lacks vascular tissues and seeds is: *(1992)*

a. Pteridophyta b. Rhodophyta
c. Bryophyta d. Phaeophyta

59. Bryophytes are amphibians because: *(1991)*

a. They require a layer of water for carrying out sexual reproduction
b. They occur in damp places
c. They are mostly aquatic
d. All the above

60. Moss peristome takes part in: *(1990)*

a. Spore dispersal b. Photosynthesis
c. Protection d. Absorption

61. Apophysis in the capsule of *Funaria* is: *(1990)*

a. Lower part b. Upper part
c. Middle part d. Fertile part

Pteridophytes

62. Identify the pair of heterosporous pteridophytes among the following: [MR*] *(2023)*

a. *Equisetum* and *Salvinia* b. *Lycopodium* and *Selaginella*
c. *Selaginella* and *Salvinia* d. *Psilotum* and *Salvinia*

63. Match List-I with List-II. [MR*] *(2023-Manipur)*

	List-I		List-II
(A)	Pteropsida	(I)	*Psilotum*
(B)	Lycopsida	(II)	*Equisetum*
(C)	Psilopsida	(III)	*Adiantum*
(D)	Sphenopsida	(IV)	*Selaginella*

Choose the **correct** answer from the options given below:

a. A-II, B-III, C-I, D-IV b. A-III, B-I, C-IV, D-II
c. A-II, B-III, C-IV, D-I d. A-III, B-IV, C-I, D-II

64. Genera like *Selaginella* and *Salvinia* produce two kinds of spores. Such plants are known as: *(2021)*

a. Heterosorus b. Homosporous
c. Heterosporous d. Homosorus

65. Strobili or cones are found in: *(2020)*

a. *Pteris* b. *Marchantia*
c. *Equisetum* d. *Salvinia*

66. From evolutionary point of view, retention of the female gametophyte with developing young embryo on the parent sporophyte for some time, is first observed in *(2019)*

a. Liverworts b. Mosses
c. Pteridophytes d. Gymnosperms

67. In bryophytes and pteridophytes, transport of male gametes requires: *(2016 - I)*

a. Wind b. Insects
c. Birds d. Water

68. *Selaginella* and *Salvinia* are considered to represent a significant step toward evolution of seed habit because: *(2011 Mains)*

a. Megaspores possess endosperm and embryo surrounded by seed coat
b. Embryo develops in female gametophyte which is retained on parent sporophyte
c. Female gametophyte is free and gets dispersed like seeds
d. Female gametophyte lacks archegonia

69. Compared with the gametophytes of the bryophytes the gametophytes of vascular plants tend to be: *(2011 Pre)*

a. Smaller and to have smaller sex organs
b. Smaller but to have larger sex organs
c. Larger but to have smaller sex organs
d. Larger and to have larger sex organs

70. Which is important in development of seed habit? *(2009)*

a. Dependent sporophyte b. Haplontic life cycle
c. Heterospory d. Free-living gametophyte

71. A vascular cryptogam is: [OS] *(2009)*

a. *Cedrus* b. *Ginkgo*
c. *Marchantia* d. *Equisetum*

72. Which is heterosporous? *(2008)*

a. *Salvinia* b. *Adiantum*
c. *Dryopteris* d. *Equisetum*

73. In prothallus of vascular cryptogams, antherozoids and eggs mature at different times resulting in: *(2007)*

a. High degree of sterility
b. Apomixis
c. Prevention of self fertilisation
d. No change in success rate of fertilisation

74. Plants reproducing by spores such as mosses and ferns are grouped under the general term: *(2003)*

a. Cryptogams b. Bryophytes
c. Sporophytes d. Thallophytes

75. In ferns, meiosis takes place at the time of: *(2000)*

a. Spore formation
b. Spore germination
c. Gamete formation
d. Antheridia and archegonia formation

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76. Heterospory and seed habit are often exhibited by a plant possessing: *(1997)*
a. Petiole b. Ligule
c. Bract d. Spathe

77. Pteridophytes differ from bryophytes and thallophytes in having: *(1993)*
a. Vascular tissues b. Motile antherozoids
c. Archegonia d. Alternation of generations

78. Pteridophytes differ from mosses/bryophytes in possessing: *(1993)*
a. Independent gametophyte
b. Well developed vascular system
c. Archegonia
d. Flagellate spermatozoids

79. Which one of the following is not common between *Funaria* and *Selaginella*? *(1992)*
a. Archegoniums b. Embryo
c. Flagellate sperms d. Roots

80. Sperms of both *Funaria* and *Pteris* were released together near the archegonia of *Pteris*. Only its sperms enter the archegonia as: **[OS]** *(1989)*
a. *Pteris* archegonia repel *Funaria* sperms
b. *Funaria* sperms get killed by *Pteris* sperms
c. *Funaria* sperms are less mobile
d. *Pteris* archegonia release chemical to attract its sperms

81. Evolutionary important character of *Selaginella* is: *(1989)*
a. Heterosporous nature b. Rhizophore
c. Strobili d. Ligule

Gymnosperms

82. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R: **[MR*]** *(2023)*

Assertion A: In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

Reason R: Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

In the light of the above statements, choose the correct answer from the options given below:
a. A is false but R is true.
b. Both A and R are true and R is the correct explanation of A.
c. Both A and R are true but R is NOT the correct explanation of A.
d. A is true but R is false.

83. Match List-I with List-II: **[MR*]** *(2022 Re)*

List-I		List-II	
(A)	*Chlamydomonas*	(I)	Moss
(B)	*Cycas*	(II)	Pteridophyte
(C)	*Selaginella*	(III)	Alga
(D)	*Sphagnum*	(IV)	Gymnosperm

Choose the correct ans... given b...
a. A-II, B-III, C-I, D-IV
b. A-III, B-I, C-II, D-IV
c. A-III, B-IV, C-II, D-I
d. A-III, B-II, C-I, D-IV

84. Which of the following statements is Incorrect ... gymnosperms? *(2006)*
a. Male and female gametophytes are free living
b. Most of them have narrow leaves with thick cuti...
c. Their seeds are not covered
d. They are heterosporous

85. *Pinus* seed cannot germinate and established without ... association. This is because : *(2...*
a. Its embryo is immature.
b. It has obligate association with mycorrhizae.
c. It has very hard seed coat.
d. Its seeds contain inhibitors that prevent germinati...

86. Which of the following statement is correct? **[MR*]** *(2...*
a. Ovules are not enclosed by ovary wall in gymnosp...
b. *Selaginella* is heterosporous, while *Salvi...* homosporous
c. Horsetails are gymnosperms
d. Stems are usually unbranched in both *Cycas* and *C...*

87. Winged pollen grains are present in **[OS]** *(2...*
a. Mustard b. *Cycas*
c. Mango d. *Pinus*

88. Select the mismatch: **[MR*]** *(2012...*
a. *Pinus* – Dioecious
b. *Cycas* – Dioecious
c. *Salvinia* – Heterosporous
d. *Equisetum* – Homosporous

89. Conifers are adapted to tolerate extreme environ... conditions because of: *(20...*
a. Thick cuticle b. Presence of vessels
c. Broad hardy leaves d. Superficial stomata

90. Select the correct statement. *(20...*
a. Gymnosperms are both homosporous and heterosp...
b. *Salvinia, Ginkgo* and *Pinus* all are gymnosperms
c. *Sequoia* is one of the tallest trees
d. The leaves of gymnosperms are not well adapt... extremes of climate

91. Which one is wrong statement? **[MR*]** *(...*
a. *Mucor* has biflagellate zoospores
b. Haploid endosperm is typical feature of gymnosp...
c. Brown algae have chlorophyll *a* and *c* and fucoxa...
d. Archegonia are found in Bryophyta, Pteridophy... Gymnosperms.

92. Read the following statements (A-E) and answer the question which follows them: **[MR*]** *(2013)*
A. In liverworts, mosses, and ferns gametophytes are free-living
B. Gymnosperms and some ferns are heterosporous
C. Sexual reproduction in *Fucus*, *Volvox* and *Albugo* is oogamous
D. The sporophyte in liverworts is more elaborate than that in mosses
E. Both *Pinus* and *Marchantia* are dioecious.
How many of the above statements are correct?
a. Four b. One
c. Two d. Three

93. Besides paddy fields, Cyanobacteria are also found inside vegetative part of: **[OS]** *(2013)*
a. *Psilotum* b. *Pinus*
c. *Cycas* d. *Equisetum*

94. Which one of the following pairs is wrongly matched? *(2012 Mains)*
a. *Ginkgo* - Archegonia b. *Salvinia* - Prothallus
c. Viroids - RNA d. Mustard - Synergids

95. Read the following five statements (A - E) and answer as asked next to them.
A. In *Equisetum*, the female gametophyte is retained on the parent sporophyte.
B. In *Ginkgo*, male gametophyte is not independent.
C. The sporophyte in *Riccia* is more developed than that in *Polytrichum*.
D. Sexual reproduction in *Volvox* is isogamous.
E. The spores of slime moulds lack cell walls.
How many of the above statements are correct? **[OS]** *(2012 Mains)*
a. Two b. Three
c. Four d. One

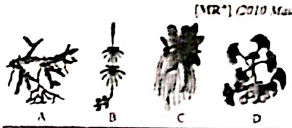
96. *Cycas* and *Adiantum* resemble each other in having: *(2012 Pre)*
a. Vessels b. Seeds
c. Motile Sperms d. Cambium

97. Which one of the following is a correct statement? *(2012 Pre)*
a. Origin of seed habit can be traced in pteridophytes
b. Pteridophyte gametophyte has a protonemal and leafy stage
c. In gymnosperms, female gametophyte is free-living
d. Antheridiophores and archegoniophores are present in pteridophytes

98. Consider the following four statements whether they are correct or wrong?
A. The sporophyte in liverworts is more elaborate than that in mosses
B. *Salvinia* is heterosporous
C. The life-cycle in all seed bearing plants is diplontic
D. In *Pinus*, male and female cones are borne on different trees

The two wrong statements together are **[MR*]** *(2011 Mains)*
a. Statements (B) and (C) b. Statements (A) and (B)
c. Statements (A) and (C) d. Statements (A) and (D)

99. Examine the figure A, B, C and D. In which one of the options all the items A, B, C and D are correct **[MR*]** *(2010 Mains)*



	A	B	C	D
a.	*Chara*	*Marchantia*	*Fucus*	*Pinus*
b.	*Equisetum*	*Ginkgo*	*Selaginella*	*Lycopodium*
c.	*Selaginella*	*Equisetum*	*Salvinia*	*Ginkgo*
d.	*Funaria*	*Adiantum*	*Salvinia*	*Riccia*

100. Gametophytes does not have free independent existence in: *(2004)*
a. *Funaria* b. *Polytrichum*
c. *Cedrus* d. *Dryopteris*

101. *Gnetum*, a gymnosperm, differs from *Cycas* and *Pinus* but shows affinities with angiosperms in the features. **[OS]** *(2004)*
a. Perianth an two integuments
b. Embryo development and apical meristem
c. Absence of resin ducts and leaf venation
d. Presence of vessel elements and absence of archegonia

102. Which set contains flagellated male gametes? **[OS]** *(2007)*
a. *Spirogyra, Anthoceros* and *Funaria*
b. *Zygnema, Sphaerocarpus* and *Hydrilla*
c. *Fucus, Marsilea* and *Calotropis*
d. *Riccia, Dryopteris* and *Cycas*

103. Pollen chambers present in gymnosperms represents: **[OS]** *(2007)*
a. Microsporangium
b. Pollen grain cell where sperms are formed
c. Opening of megagametophyte for passage of pollen tube to egg
d. Cavity in nucellus for resting pollen grains after pollination

104. Which one of the following is a living fossil? **[OS]** *(2004)*
a. Moss b. *Saccharomyces*
c. *Spirogyra* d. *Cycas*

105. Which one of the following pairs of plants are not seed producers? *(2003)*
a. Fern and *Funaria*
b. *Funaria* and *Ficus*
c. *Ficus* and *Chlamydomonas*
d. *Pinus* and *Pinus*

106. Which one of the following is categorised under living fossils? **[OS]** *(2003)*
a. *Pinus* b. *Cycas*
c. *Selaginella* d. *Metasequoia*

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107. *Cycas* have two cotyledons but not included in angiosperms because of: *(2001)*
a. Naked ovules b. Seems like monocot
c. Circinate ptyaxis d. Compound leaves

108. Plant group with largest ovule, largest tree, and largest gametes: *(2000)*
a. Gymnosperm b. Angiosperm
c. Bryophyta d. Pteridophyta

109. Which statement is wrong for *Cycas*? *(1998)*
a. Xylem have vessels
b. Male cones are well-developed
c. It has coralloid roots
d. Circinate vernation ptyxis

110. Largest sperm is: [OS] *(1998)*
a. *Pinus* b. *Cycas*
c. *Ephedra* d. *Sequoia*

111. The smallest plant family 'Gymnosperm' has how many species? [OS] *(1996)*
a. 640 b. 300
c. 1000 d. 900

112. A gymnospermic leaf carries 16 chromosomes. The number of chromosomes in its endosperm will be: *(1996)*
a. 12 b. 8
c. 16 d. 24

113. In *Pinus*, the wings of the seed develops from: [OS] *(1994)*
a. Ovuliferous scale b. Integument
c. Nucellus d. Bract

114. Which one is the most advanced from evolutionary view point? *(1993)*
a. *Selaginella* b. *Funaria*
c. *Chlamydomonas* d. *Pinus*

115. *Pinus* differs from mango in having: *(1993)*
a. Tree habit
b. Green leaves
c. Ovules not enclosed in ovary
d. Wood

116. Resin and turpentine are obtained from: [OS] *(1992)*
a. *Cycas* b. *Pinus*
c. *Cedrus* d. *Abies*

117. In *Pinus*, the pollen grain has 6 chromosomes then in its endosperm will have: *(1992)*
a. 12 b. 18
c. 6 d. 24

118. A plant having seeds but lacking flowers and fruits belongs to: *(1992)*
a. Pteridophytes b. Mosses
c. Ferns d. Gymnosperms

119. In *Pinus*, the haploid structure are: [MR*] *(1989)*
a. Megaspore, endosperm and embryo
b. Megaspore, pollen grain and endosperm
c. Megaspore, integument and root
d. Pollen grain, leaf and root

120. In gymnosperms, the endosperm is:
a. Triploid b. Haploid
c. Diploid d. Tetraploid

Plant Life Cycles

121. Which of the following statements is true? [MR*] *(2023-M...*
a. All pteridophytes exhibit haplo-diplontic pattern.
b. Seed bearing plants follow haplontic pattern
c. Most algal genera are diplontic
d. Most bryophytes do not have haplo-diplontic life cy...

122. Match the plant with the kind of life cycle it exhibits:

List-I		List-II	
(A)	*Spirogyra*	(i)	Dominant diploid sporop... vascular plant, with highly red... male or female gametophyte
(B)	Fern	(ii)	Dominant haploid free-living gametophyte
(C)	*Funaria*	(iii)	Dominant diploid sporop... alternating with red... gametophyte called prothallu...
(D)	*Cycas*	(iv)	Dominant haploid ... gametophyte alternating w... partially dependent multicell... sporophyte

Choose the correct answer from the options given be... [MR*] (2...
a. A-ii B-iv C-i D-iii
b. A-iv B-i C-ii D-iii
c. A-ii B-iii C-iv D-i
d. A-iii B-iv C-i D-ii

123. Life cycle of *Ectocarpus* and *Fucus* respectively ... *(2017-Dr...*
a. Haplontic, Diplontic
b. Diplontic, Haplodiplontic
c. Haplo-diplontic, Diplontic
d. Haplo-diplontic, Haplontic

124. Zygotic meiosis is characteristic of: [OS] *(2017-Dr...*
a. *Marchantia* b. *Fucus*
c. *Funaria* d. *Chlamydomonas*

125. Which one has haplontic life cycle? [2...
a. Wheat b. *Funaria*
c. *Polytrichum* d. *Ustilago*

126. Which one has the largest gametophyte? [OS] (...
a. *Cycas* b. Angiosperm
c. *Selaginella* d. Moss

Answer Key

1. (c)	2. (d)	3. (d)	4. (b)	5. (a)	6. (b)	7. (b)	8. (c)	9. (c)	10. (d)
11. (b)	12. (d)	13. (c)	14. (a)	15. (d)	16. (b)	17. (d)	18. (a)	19. (c)	20. (d)
21. (b)	22. (d)	23. (a)	24. (b)	25. (a)	26. (a)	27. (c)	28. (a)	29. (a)	30. (b)
31. (d)	32. (d)	33. (b)	34. (c)	35. (c)	36. (a)	37. (a)	38. (a,d)	39. (b)	40. (c)
41. (a)	42. (a)	43. (c)	44. (b)	45. (b)	46. (c)	47. (d)	48. (c)	49. (c)	50. (c)
51. (a)	52. (a)	53. (d)	54. (b)	55. (b)	56. (d)	57. (b)	58. (c)	59. (a)	60. (a)
61. (a)	62. (c)	63. (d)	64. (c)	65. (c)	66. (c)	67. (d)	68. (b)	69. (a)	70. (c)
71. (d)	72. (a)	73. (c)	74. (a)	75. (a)	76. (b)	77. (a)	78. (b)	79. (d)	80. (d)
81. (a)	82. (d)	83. (c)	84. (a)	85. (b)	86. (a)	87. (d)	88. (a)	89. (a)	90. (c)
91. (a)	92. (d)	93. (c)	94. (a)	95. (d)	96. (c)	97. (a)	98. (d)	99. (c)	100. (c)
101. (d)	102. (d)	103. (d)	104. (d)	105. (a)	106. (b)	107. (a)	108. (a)	109. (a)	110. (b)
111. (d)	112. (b)	113. (a)	114. (d)	115. (c)	116. (b)	117. (c)	118. (d)	119. (b)	120. (b)
121. (a)	122. (c)	123. (c)	124. (d)	125. (d)	126. (d)				

Explanations

1. **(c)** Phylogenetic system of classification brings out evolutionary relationships of organisms.

2. **(d)** Phenetic classification is based on observable characteristics of an existing organism. The observable characteristics means the morphology and other observable traits, regardless of their phylogeny or evolutionary relation.

3. **(d)** Phylogenetic classification is classification of organisms based on their assumed evolutionary histories and relationships. This system place organisms in a clade, i.e., group of organisms descended from a common ancestor.

4. **(b)** Ordering of organisms into groups on the basis of non-evolutionary features, e.g., grouping plants according to their number and position of stamens, styles & stigmas. This type of classification system is called Artificial system of classification used by Carolus Linnaeus.

5. **(a)** Carolus Linnaeus used the Artificial system of classification. He classified the plants on the basis of number of stamens & their cohesion. This system was easy to use because a few characters had to be recognised.

6. **(b)** The concept of Natural classification was initiated by Michel Adanson and used by Bentham and Hooker. They analyzed the overall similarity (both external and internal features) for determining the relationship amongst taxa.

7. **(b)** Phaeophyceae and Rhodophyceae

Fucoxanthin pigment is found in Phaeophyceae and phycoerythrin pigment is found in Rhodophyceae.

8. **(c)** The alga shown in the diagram is *Chara*, a member of Chlorophyceae. It is a monoecious plant showing oogonium and antheridium. Food in *Chara* is stored in the form of starch and it shows dominance of pigments Chlorophyll *a*, *b*.

9. **(c)** *Volvox* and *Ulothrix* are green algae. Their food is stored in the form of starch. *Ectocarpus* is brown algae. Chlorophyll a, c and fucoxanthin are major pigments of brown algae. The food is stored in the form of mannitol or laminarin. *Porphyra* is red *algae*. The food is stored in the form of floridean starch.

10. **(d)** Carrageen is a type of hydrocolloid (water-holding substance) which is obtained from rhodophyceae (red algae). It is used commercially as a thickener and stabilizer in milk products, i.e., icecream and processed foods.

11. **(b)** Some brown and red algae are known to produce water holding substances called hydrocolloids. For example, brown algae produces algin and red algae produce carrageen.

12. **(d)** Mannitol and Laminarin are reserved food material of brown algae or phaeophyceae. Among the given options, *Ectocarpus* is brown algae. *Ulothrix* and *Volvox* are green algae. *Gracilaria* is red algae.

13. **(c)** *Chlorella* and *Spirulina* are unicellular algae.

14. **(a)** In red algae, floridean starch is stored food material. Its structure is very much similar to amylopectin and glycogen.

15. **(d)** The members of rhodophyceae are commonly called red algae. They contains a red pigment, r-phycoerythrin, in their body.

16. **(b)** The form and size of algae is highly variable. The size ranges from the microscopic unicellular forms like *Chlamydomonas*, to colonial forms like *Volvox* and to the filamentous forms like *Ulothrix* and *Spirogyra*.

17. **(d)** Certain marine brown and red algae produce large amounts of hydrocolloids (water holding substances), e.g., Algin (brown algae) and carrageen (red algae) which are used commercially.

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18. **(a)** *Ectocarpus* belongs to the group of brown algae. Gametes are pyriform (pear-shaped) and bear two laterally attached flagella in phaeophyceae (Brown algae).

19. **(c)** *Spirogyra* has isogamous condition with non-flagellate gametes.

20. **(d)** In oogamous reproduction, female has large size, non - motile gametes and male has small size - motile gametes.

21. **(b)** In cyanophyta, sexual reproduction is absent, but gene recombination can occur through conjugation, transformation and transduction.

22. **(d)** Laminarin and mannitol are storage food of brown algae. *E.g.*, *Dictyota*, *Laminaria*, *Fucus*, *Ectocarpus* and *Sargassum*

23. **(a)** Oogamy is a form of heterogamy in which the female gamete is significantly larger than the male gamete (small, motile) and is non - motile.

24. **(b)** Major pigments that are found in rhodophyceae are chlorophyll a, d & phycoerythrin. Phaeophyceae contains chlorophyll a, c & fucoxanthin.

25. **(a)** *Ulothrix* is a member of chlorophyceae & is a genus of filamentous green algae. In these, zoospores (reproductive structures) are flagellated & produced in zoosporangia.

26. **(a)** *Chlorella* contains over 50% protein, a much higher percentage than either soyabeans or rice. It also contains some amino acids known to be essential to human nutrition.

27. **(c)** Filamentous zoospores of *Ulothrix* produce isogametes, i.e., male & female gametes are identical to each other.

28. **(a)** Members of phaeophyceae or brown algae possess chlorophyll *a*, *c*, xanthophyll and fucoxanthin pigment in them.

29. **(a)** In chlorophyceae, most of the members have one or more storage bodies, called pyrenoids, located in chloroplasts. They contain protein surrounded by starch.

30. **(b)** *Nostoc* is a filamentous blue-green algae that belongs to kingdom Monera. *Spirogyra*, *Ulothrix* & *Volvox* are green algae and belongs to kingdom Plantae. Members of chlorophyceae (green algae) show considerable variation in type & formation of sex cells.

31. **(d)** Sexual reproduction in chlorophyceae shows considerable variation in the type of sex cells & their formation. Gametes may be isogamous, anisogamous or oogamous.

32. **(d)** Pyrenoids are storage bodies found in chlorophyceae. It stores starch.

33. **(b)** Chloroplast in *Chlamydomonas* is cup-shaped.

34. **(c)** In *Ulothrix*/*Spirogyra*, reduction division (meiosis) occurs at the time of zygospore germination.

35. **(c)** In algae, such as *Chlamydomonas*, sexual reproduction takes place through fusion of two similar, flagellated gametes to produce zygote that disperse as spores. In other examples, sporophytic generation is represented by spores (*Selaginella* & *Dryopteris*) or seeds (*Pinus*).

36. **(a)** In *Chlamydomonas*, commonly the gametes are flagellated & similar in size, called isogamy.

37. **(a)** In algae, sexual ... of two gametes which result in formation of ... zygospore. This is called isogamous.

38. **(a,d)** Hologamy is sexual fusion of mature organisms ... do not differ morphologically from ordinary individuals ... are recognised as gametes.

e.g., *Chlamydomonas*.

39. **(b)** Mosses spores released from the capsule germinate ... form the filamentous structure called protonema. It is ... first stage of gametophyte.

40. **(c)** In liverworts, asexual reproduction takes place by ... process of fragmentation or by the formation of specialized ... structures called gemmae. These are green colored ... multicellular, asexual buds, which develop in ... receptacles called gemma cups present on the thalli. Mosses ... (bryophytes) reproduce vegetatively by fragmentation ... budding of secondary protonema.

41. **(a)** *Polysiphonia* exhibits anisogamy, i.e., unequal gametes ... and in them, gametes are not usually flagellated.

42. **(a)** Multiplication by fragmentation is common ... multicellular fungi, filamentous algae and Protonema ... Mosses.

43. **(c)** The given figure is of female thallus of *Marchantia* ... where A is archegoniophore, B is female thallus, C is gemma ... cup and D is rhizoids.

44. **(b)** Elaters are hygroscopic and help in spore's dispersal.

45. **(b)** Moss peat is used in horticulture and added to soil ... improve its water holding capacity. It is used as packing ... material for living plants.

46. **(c)** In a moss, sporophyte is semi-parasitic as the sporophyte ... is not completely embedded in the gametophyte.

47. **(d)** In *Spirogyra*, sexual reproduction is isogamous and ... conjugation. During this, two filaments come near each other ... & the conjugation tube arise from lateral walls of the cells. ... Protoplast form gametes. One gamete become motile ... move from one filament to other (male gamete) and other ... passive, remains in the cell (female). Thus, *Spirogyra* exhibits ... physiological anisogamy.

48. **(c)** Main plant body or bryophyte is haploid. It produces ... gametes, hence is called a gametophyte. The sex organs of ... bryophytes are multicellular. Zygotes produce a multicellular ... body called sporophyte, which is not free-living but attached ... to photosynthetic gametophyte and derives nourishment ... from it. Thus, in bryophyta, gametophytes are dominant and ... sporophytes are parasitic.

49. **(c)** In bryophyta, male sex organ (antheridium) produces ... biflagellate male gametes (antherozoids). *Funaria*, a moss ... belongs to bryophyta, have biflagellate male gametes.

50. **(c)** Male gametes, antherozoids, are released into water ... where they come in contact with archegonium (female sex ... organ). An antherozoid then fuses with the egg to produce ... zygote.

51. **(a)** Algae contains oogonia whereas female sex organ of ... bryophyta is called archegonia that produce a single egg.

52. **(a)** Plant body of bryophyta is thallus-like and attached to substratum by unicellular or multicellular rhizoids. In mosses, second stage of gametophyte is leafy which remains attached to soil through multicellular branched rhizoids. This leafy stage becomes the sex organ.

53. **(d)** Bryophytes are also called amphibians of plant kingdom because these plants can live in soil but are dependent on water for sexual reproduction.

54. **(b)** In *Riccia*, elaters are absent and in *Funaria*, peristome teeth help in spore dispersal.

55. **(b)** The predominant stage of the life cycle of a moss is the gametophyte which consist of two stages - first, protonema stage and second leafy stage. After fertilization, the zygote develops into a sporophyte consist of foot, seta & capsule.

56. **(d)** Sporophytes in bryophyta are not free - living. They are attached to the photosynthetic, dominant phase of their life cycle - gametophytes. Sporophytes derive their nourishment from gametophytes.

57. **(b)** First stage of gametophyte is protonema stage, which develops directly from a spore. This stage is a creeping, green, branched, filamentous and found only in mosses including *Funaria*, *Sphagnum*, etc.

58. **(c)** Bryophytes are avascular and they do not possess seeds. Reproduction takes place through haploid spores which germinate to form new plant body.

59. **(a)** In bryophytes, antherozoids (male gametes) are released into water where they come in contact with female sex organ & complete their sexual reproduction.

60. **(a)** Most mosses produce a capsule with a lid which falls off when the spores inside are ready to get disperse. Opening is called the stoma which is surrounded by one or two peristomes.

61. **(a)** Apophysis is a swelling at the base of the sporangium (capsule) in some mosses, such as *Funaria*.

62. **(c)** Genera like *Selaginella* and *Salvinia* which produce two kinds of spores, macro (large) and micro (small) spores, are known as heterosporous.

63. **(d)** (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Pteropsida - *Adiantum*

Lycopsida - *Selaginella*

Psilopsida - *Psilotum*

Sphenopsida - *Equisetum*

64. **(c)** *Selaginella* and *Salvinia* are members of Pteridophytes. They both produce two types of spores, i.e., marco (large) spores and the micro (small) spores. Thus, they are called as heterosporous.

65. **(c)** In *Equisetum*, sporophylls are compactly arranged into structures called strobili or cones.

66. **(c)** In Pteridophyte, the female gametophyte is retained on the parent sporophyte for variable periods. The development of the zygotes into young embryos take place within the female gametophytes. This event is a precursor to the seed habit considered an important step in evolution.

67. **(d)** In bryophytes and pteridophytes, transport of male gametes requires water.

Bryophytes are also called amphibians of the plant kingdom because these plants can live in soil but are dependent on water for sexual reproduction. Due to need of water for fertilisation, the spread of living pteridophytes is limited and restricted to narrow geographical regions.

68. **(b)** The development of the zygotes into young embryos take place within the female gametophytes. This event is a precursor to the seed habit considered an important step in evolution.

69. **(a)** Gametophyte is reduced in vascular plant. It is smaller and also bear smaller sex organs.

70. **(c)** The development of the zygotes into young embryo takes place within the female gametophytes. This event is a precursor of the seed habit.

71. **(d)** *Equisetum* consists of vascular system containing collateral vascular strands.

72. **(a)** *Salvinia* and *Selaginella* are heterosporous.

73. **(c)** Dichogamy is the condition of bisexuals flower in which male and female reproductive parts mature at different times. This discourages the self pollination.

74. **(a)** Cryptogam is a plant that reproduces by spores, without flower or seeds (*Crypto* → hidden + *gamae* → gametes). Thus, they represent non-seed bearing plants. They include mosses, algae, ferns.

75. **(a)** In pteridophytes, sporophyte is the main plant body that bear sporangia. These sporangia produce spores by meiosis in spore mother cells. Spores germinate to give rise to inconspicuous, small multicellular gametophytes.

76. **(b)** A ligule is a thin outgrowth at the junction of leaf & leaf stalk of many grasses and sedges. Plants having ligule , such as *Selaginella*, show heterospory and seed habit.

77. **(a)** Pteridophytes differs from bryophytes and thallophytes in having well developed vascular tissue system.

78. **(b)** Pteridophytes are the first terrestrial plants that possess vascular tissues - xylem & phloem. These vascular tissues/ conduction system are absent in algae & bryophytes.

79. **(d)** *Selaginella*, being a pteridophyte, possess true roots, stems & leaves but bryophyta (e.g., *Funaria*) lacks true roots, stem or leaves.

80. **(d)** Fertilisation of male & female gametophytes is very specific in any species. This specificity is under the chemoregulation. Chemicals releases through female sex organ make sure that male gametophyte of same species enters the female part.

81. **(a)** *Selaginella* are heterosporous and therefore, they have 2 types of sporangia - microsporangia & megasporangia. From the point of view of reproduction, it is considered as evolutionary important character.

82. **(d)** In gymnosperms, the pollen grain is released from the microsporangium. They are carried in air currents and come in contact with the opening of the ovules borne on megasporophylls. The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia.

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83. (c)

A. *Chlamydomonas* - (III) Alga

B. *Cycas* - (IV) Gymnosperm

C. *Selaginella* - (II) Pteridophyte

D. *Sphagnum* - (I) Moss

84. (a) The gymnosperms are plants in which the ovules are not enclosed by any ovary wall and remain exposed. In gymnosperms the male and the female gametophytes do not have an independent free-living existence.

85. (b) Fungus associated with roots of *Pinus* increases minerals and water absorption for the plant by increasing surface area and in turn fungus gets food from plant. Therefore, mycorrhizal association is obligatory for *Pinus* seed germination.

86. (a) In gymnosperms, ovules are naked, i.e., they are not covered by any ovary wall (which is present in angiosperms).

87. (d) The pollen grains of *Pinus* are very buoyant due to presence of sacs and thus float in the fluid. Hence, winged pollen grains are characteristic feature of *Pinus*.

88. (a) *Pinus* is monoecious plant having both male and female cones on same plant.

89. (a) In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss.

90. (c) One of the gymnosperms, the giant redwood tree *Sequoia* is one of the tallest tree species. *Cycas*, *Pinus* & *Ginkgo* are gymnosperms. The gymnosperms are heterosporous; they produce haploid microspores and megaspores. The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind.

91. (a) Mucor spores (or sporangiospores) can be simple or branched & form apical, globular sporangia supported by column-shaped columella.

92. (d) The male or female cones or strobili may be borne on same tree in *Pinus*. So, this happens in the case of monoecious.

The sporophyte of moss is more elaborate than liverworts.

93. (c) Besides paddy fields, cyanobacteria are also found inside vegetative part of *Cycas*.

94. (a) Archegonia is not found in *Ginkgo*

95. (d) *Equisetum*: Homosporous pteridophyte

Riccia: Simplest sporophyte among bryophytes.

Volvox: Sexual reproduction is oogamous type

Slime moulds: Spores are haploid with reticulately thickened cell walls.

96. (c) *Cycas* (Gymnosperm) and *Adiantum* (Pteridophytes) both have motile sperms.

97. (a) The development of the zygotes into young embryos take place within the female gametophytes. This event is a precursor to the seed habit considered an important step in evolution.

98. (d) The mosses have an elaborate mechanism of spore dispersal. Common examples of mosses are *Funaria*, *Polytrichum* and *Sphagnum*.

The male or female cones or strobili may be borne on the same tree *(Pinus)*. However, in *Cycas* male cones and megasporophylls are borne on different trees.

99. (c) A-*Selaginella*, B-*Equisetum*, C-*Salvinia*, D-*Ginkgo*

100. (c) Unlike bryophytes and pteridophytes, the male and female gametophyte in gymnosperms do not have an independent free-living existence. They remain within the sporangia retained on the sporophytes.

101. (d) *Gnetum* includes advanced gymnosperm. Secondary xylem shows vessels unlike *Cycas* and *Pinus*; it does not have archegonia.

102. (d) *Riccia*, *Dryopteris* and *Cycas* have motile male gametes.

103. (d) Pollen chambers represents nucellar cavity for storage of pollen grains.

104. (d) *Cycas*, a gymnosperm, is a living fossil. It has remained essentially unchanged from earlier geological times and its close relatives are extinct.

105. (a) Among all the 5 classified groups of plant kingdom, gymnosperms & angiosperms are seed producing plants. Fern is a pteridophyta & *Funaria* is a moss. Both lacks seed & reproduce by spores.

106. (b) There is a clear evidence of cycas-type plants that are existing as far back as the paleozoic era. So *Cycas* is considered to be a living fossil.

107. (a) In *Cycas*, the seeds are not covered by fruits and are called naked seeds, a characterising feature of gymnosperms. Thus, *Cycas* is a gymnosperm.

108. (a) Mostly the plants of gymnosperms are tall. Gymnosperms include medium sized trees or tall trees & shrubs. One of the gymnosperms, the giant redwood tree *Sequoia* is one of the tallest tree species.

109. (a) Xylem present in the stem of *Cycas* lacks vessels.

110. (b) The sperm of *Cycas* is, perhaps, the largest. Large motile sperm cells of *Cycas* are unusual for a seed plant. It is about 200-300 µm in size and visible to naked eye.

111. (d) Gymnosperms originated about 200 million years ago and were dominant species at that time. There are around 900 living species of this group.

112. (b) In gymnosperms, the endosperm is formed in ovule during germination of megaspore. It consequently becomes the female gametophyte, with a haploid set of chromosome.

113. (a) Ovuliferous scales are scales on which the ovules are borne in the female cones of a gymnosperm. They are large woody specialized leaves bearing ovules, which develop into seeds.

114. (d) *Pinus* is more advanced from the evolutionary point of view.

115. (c) *Pinus* is a gymnosperm in which seeds are naked, and mango is an angiosperm, i.e., seeds in mangoes are covered by fruits. Therefore, in mango ovule is surrounded & enclosed in ovary as after fertilisation ovule change into seed and ovary into fruits. In members of gymnosperms, ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilisation.

116. (b) Resins and turpentine are obtained from *Pinus* which is a gymnospermic plant.

117. (c) Both pollen grain and endosperm are haploid and thus contains equal number of chromosomes.

118. (d) Flowers & fruits cover and protect the reproductive structures, i.e., seeds & gametes. In gymnosperms, seeds remains exposed and are not covered.

119. (b) Gymnosperms are heterosporous, i.e., they produce haploid microspores & haploid megaspores. The haploid microspores develop into male gametophyte called pollen grain (haploid). Endosperm formed in gymnosperms are also haploid, i.e., having one set of chromosome.

120. (b) In gymnosperms, endosperm does not form after fertilisation and has one set of chromosomes and therefore, it is haploid.

121. (a) All pteridophytes exhibit haplo-diplontic pattern.

Bryophytes and pteridophytes exhibit an intermediate condition called Haplo-diplontic where both phases are multicellular but they differ in their dominant phases. All seed-bearing plants (gymnosperms and angiosperms) follow a diplontic life cycle pattern, not haplontic. Many algae such as *Volvox*, *Spirogyra* are haplontic while only *Fucus* sp., represents diplontic life cycle.

122. (c) Many algae such as *Volvox*, *Spirogyra* and some species of *Chlamydomonas* have haplontic life cycle. In this, the dominant, photosynthetic phase represents free-living gametophyte.

All bryophytes, e.g., *Funaria*, represent haplo-diplontic life cycle. A dominant, independent, photosynthetic, thalloid or erect phase is represented by a haploid gametophyte and it alternates with the shortlived multicellular sporophyte totally or partially dependent on the gametophyte for its anchorage and nutrition.

All pteridophytes, e.g., fern, represent haplo-diplontic life cycle. The diploid sporophyte is represented by a dominant, independent, photosynthetic, vascular plant body. It alternates with multicellular, saprophytic/autotrophic, independent but short-lived haploid gametophyte.

Gymnosperms have dominant diploid sporophyte vascular plant, with highly reduced male or female gametophyte. E.g., *Cycas*

123. (c) Some of the algal genera such as *Ectocarpus*, *Polysiphonia*, kelps are haplo-diplontic. *Fucus*, an alga is diplontic.

124. (d) In haplontic life cycle, meiosis in the zygote results in the formation of haploid spores. The haploid spores divide mitotically and form the gametophyte. The dominant, photosynthetic phase in such plants is the free-living gametophyte. E.g., algae such as *Volvox*, *Spirogyra* and some species of *Chlamydomonas*.

125. (d) *Ustilago* has short lived diplophase in basidium, only haplophase and dikaryophase occurs.

126. (d) Moss has the largest gametophyte.

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CHAPTER 4

Animal Kingdom

Basis of Classification

1. Bilaterally symmetrical and acoelomate animals are exemplified by: *(2020)*
   a. Platyhelminthes b. Aschelminthes
   c. Annelida d. Ctenophora
2. Consider following features
   A. Organ system level of organisation
   B. Bilateral symmetry
   C. True coelomates with segmentation of body
   Select the correct option of animal groups which possess all the above characteristics [MR*] *(2019)*
   a. Annelida, Arthropoda and Chordata
   b. Annelida, Arthropoda and Mollusca
   c. Arthropoda, Mollusca and Chordata
   d. Annelida, Mollusca and Chordata
3. Which one of the following kinds of animals are triploblastic? *(2010 Pre)*
   a. Sponges b. Ctenophores
   c. Corals d. Flatworms
4. Which one is the group of bilaterally symmetrical and triploblastic animals? *(2009)*
   a. Sponges b. Coelenterates
   c. Ctenophores d. Aschelminthes
5. Coelom is found between: *(1996)*
   a. Body wall and ectoderm
   b. Ectoderm and endoderm
   c. Mesoderm and body wall (endoderm)
   d. Mesoderm and ectoderm
6. Besides annelida and arthropoda, the metamerism is exhibited by: *(1995)*
   a. Mollusca b. Acanthocephala
   c. Cestoda d. Chordata
7. Radial symmetry is, usually, exhibited in animals which: *(1994)*
   a. Are attached to the substratum
   b. Have one opening of alimentary canal
   c. Live in water
   d. Have ciliary mode of feeding
8. Coelom derived from blastocoel is known as: *(19*
   a. Pseudocoelom b. Schizocoel
   c. Haemocoel d. Enterocoelom

Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes

9. Select the correct statements: [MR*] *(2023-Manipur*
   A. Platyhelminthes are triploblastic pseudocoelomate and bilaterally symmetrical organisms.
   B. Ctenophores reproduce only sexually and fertilization is external.
   C. In tapeworm, fertilization is internal but sexes are not separate.
   D. Ctenophores are exclusively marine, diploblastic and bioluminescent organisms.
   E. In sponges, fertilization is external and development is direct.
   Choose the correct answer from the options given below:
   a. (A), (C) and (D) only b. (B), (C) and (D) only
   c. (A) and (E) only d. (B) and (D) only
10. In case of poriferans, the spongocoel is lined with flagellated cells called: *(2017-Delhi*
    a. Ostia b. Oscula
    c. Choanocytes d. Mesenchymal cells
11. Which of the following endoparasites of humans does show viviparity? [OS] *(201*
    a. *Trichinella spiralis* b. *Ascaris lumbricoides*
    c. *Ancylostoma duodenale* d. *Enterobius vermicularis*
12. Metagenesis refers to: *(2015 Re*
    a. Alternation of generation between asexual and sexual phases of organisms
    b. Occurrence of a drastic change in form during post-embryonic development
    c. Presence of a segmented body and parthenogenetic mode of reproduction
    d. Presence of different morphic forms
13. *Planaria* possess high capacity of: *(201*
    a. Bioluminescence b. Metamorphosis
    c. Regeneration d. Alternation of generation
14. One example of animals having a single opening to the outside that serves both as mouth as well as anus is: *(2010 Pre)*
    a. *Asterias* b. *Ascidia*
    c. *Fasciola* d. Octopus
15. *Ascaris* is characterised by: *(2008)*
    a. Presence of true coelom but absence of metamerism
    b. Presence of neither true coelom nor metamerism
    c. Presence of true coelom and metamerism
    d. Absence of true coelom but presence of metamerism
16. Biradial symmetry and lack of Cnidoblasts are characteristics of: *(2006)*
    a. *Hydra* and Starfish b. Starfish and *Sea Anemone*
    c. *Ctenoplana* and *Beroe* d. *Aurelia* and *Paramecium*
17. *Sycon* belongs to a group of animals, which are best described as: *(2003)*
    a. Unicellular or acellular
    b. Multicellular without any tissue organisation
    c. Multicellular with a gastrovascular system
    d. Multicellular having tissue organisation, but no body cavity
18. In which animal nerve cell is present but brain is absent? *(2002)*
    a. Sponge b. Earthworm
    c. Cockroach d. Hydra
19. In *Hydra*, waste material of food digestion and nitrogenous waste material removed from: *(2001)*
    a. Mouth and mouth b. Body wall and body wall
    c. Mouth and body wall d. Mouth and tentacles
20. Which of the following animals have scattered cells with cell-tissue grade organisation? *(2000)*
    a. Sponge b. *Hydra*
    c. *Liver fluke* d. *Ascaris*
21. Which characteristic is true for *Obelia*? *(1998)*
    a. Metagenesis b. Morphogenesis
    c. Apolysis d. Pedogeny
22. The embryonated egg of *Ascaris* represents: [OS] *(1997)*
    a. An egg with blastula b. An egg with a juvenile
    c. An egg with an egg d. An egg with gastrula
23. Which of the following statements is without exception for sponges? *(1996)*
    a. They all have calcareous spicules
    b. They have high regenerative power
    c. They are found only in marine water
    d. They are all radially symmetrical
24. The nephridia in earthworm are analogous to: *(1996)*
    a. Nematoblasts of *Hydra* b. Flame cells of *Planaria*
    c. Gills of *Prawn* d. Trachea of insects
25. The formation of canal system in sponges is due to: *(1996)*
    a. Folding of inner walls b. Gastro-vascular system
    c. Reproduction d. Porous walls
26. The organisms attached to the substratum, generally, possess: [OS] *(1995)*
    a. One single opening of the digestive canal
    b. Cilia on the surface to create water current
    c. Radial symmetry
    d. Asymmetrical body
27. One of special characters of coelenterata only, is the occurrence of: *(1994)*
    a. Polymorphism b. Flame cells
    c. Hermaphroditism d. Nematocysts
28. Which of the following is an example of platyhelminthes? *(1994)*
    a. *Plasmodium* b. *Schistosoma*
    c. *Trypanosoma* d. *Wuchereria*
29. What is true about *Taenia saginata*? [OS] *(1993)*
    a. Life history has pig as intermediate host
    b. There are two large suckers on scolex
    c. Rostellar hooks are absent
    d. Rostellum has double circle of hooks
30. Which one of the following animals possesses nerve cells but no nerves? *(1993)*
    a. *Hydra* b. Tapeworm
    c. Earthworm d. Frog's tadpole
31. *Ascaris* larva is called: [OS] *(1992)*
    a. Cysticercus b. Rhabditiform
    c. Hexacanth d. Onchosphere
32. What is correct about *Taenia*? [OS] *(1992)*
    a. Male organs occur in posterior proglottides
    b. Male organs occur in anterior proglottides
    c. Female organs occur in anterior proglottides
    d. Mature proglottides contain both male and female organs
33. The simplest type of canal system in Porifera is: [OS] *(1992)*
    a. Ascon type b. Leucon type
    c. Sycon type d. Radial type
34. Classification of Porifera is based on: *(1991)*
    a. Branching b. Spicules
    c. Reproduction d. Symmetry
35. The excretory structures of flatworms/*Taenia* are: *(1991)*
    a. Flame cells b. Protonephridia
    c. Malpighian tubules d. Green glands
36. Bladderworm/cysticercus is the larval stage of: [OS] *(1991)*
    a. Tapeworm b. Roundworm
    c. Pinworm d. Liver fluke
37. *Taenia saginata* differs from *Taenia solium* in: [OS] *(1990)*
    a. Absence of scolex hooks
    b. Absence of scolex hooks and uterine branching
    c. Absence of scolex hooks and presence of both male and female reproductive organs
    d. Presence of scolex hooks

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70. What is common among silverfish, scorpion, crab and honey bee? *(1997)*
a. Jointed legs b. Metamorphosis
c. Compound eyes d. Poison glands

71. Among the following organisms point out a completely non-parasitic form: *(1994)*
a. Tapeworm b. Mosquito
c. Sea anemone d. Leech

72. Tube feet are the characteristic structures of: [OS] *(1994)*
a. Starfish b. Jellyfish
c. Crayfish d. Cuttlefish

73. Which one assists in locomotion? [OS] *(1993)*
a. Trichocysts in *Paramoecium*
b. Pedicellariae of star fish
c. Clitellum in *Pheretima*
d. Posterior sucker in *Hirudinaria*

74. A larval stage occurs in the life history of all members of the group: [MR*] *(1993)*
a. Frog, lizard and cockroach
b. *Ascaris*, housefly and frog
c. Housefly, earthworm and mosquito
d. Butterfly, frog and mosquito

75. Aristotle's lantern occurs in class: [OS] *(1992)*
a. Echinoidea b. Asteroidea
c. Holothuroidea d. Ophiuroidea

76. Star Fish belongs to: [OS] *(1992)*
a. Asteroidea b. Ophiuroidea
c. Holothuroidea d. Crinoidea

77. Eye of the molluscan group that resembles vertebrate eye is: [OS] *(1992)*
a. Bivalvia b. Gastropoda
c. Pelecypoda d. Cephalopoda

78. Adult *Culex* and *Anopheles* can be distinguished with the help of: [OS] *(1992)*
a. Mouth parts/colour b. Sitting posture
c. Antennae/wings d. Feeding habits

79. Which one occurs in echinodermata? *(1991)*
a. Bilateral symmetry b. Radial symmetry
c. Porous body d. Soft skin

80. An insect regarded as greatest mechanical carrier of diseases is: [OS] *(1991)*
a. *Pediculus* b. *Cimex*
c. *Musca* d. *Xenopsylla*

81. Metamorphosis of insects is regulated through hormone: [OS] *(1991)*
a. Pheromone b. Thyroxine
c. Ecdysone d. All of these

82. Ecdysis is shedding of: [OS] *(1990)*
a. Stratum corneum b. Epidermis
c. Dermis d. Stratum malpighi

83. Malpighian tubules are: *(1)*
a. Excretory organs of insects
b. Excretory organs of annelids
c. Respiratory organs of insects
d. Respiratory organs of annelids

84. Fish which can be used in biological control of mosqui... [OS] *(1)*
Larvicidal fish is:
a. *Eel* b. Carp
c. Cat fish d. *Gambusia*

85. A wood boring Shipworm is: [OS] *(1)*
a. *Chiton* b. *Teredo*
c. *Limax* d. *Patella*

86. Silk thread is obtained from silk moth during: [OS] *(1)*
a. Pupal stage b. Larval stage
c. Nymph stage d. Adult stage

Hemichordata and Chordata

87. Radial symmetry is NOT found in adults of phylum *(20...*
a. Echinodermata b. Ctenophora
c. Hemichordata d. Coelenterata

88. Select the correct statements with reference to chordat... [MR*] *(20...*
A. Presence of a mid-dorsal, solid and double nerve cord
B. Presence of closed circulatory system.
C. Presence of paired pharyngeal gills
D. Presence of dorsal heart
E. Triploblastic pseudocoelomate animals.
Choose the correct answer from the options given below:
a. C, D and E only b. A, C and D only
c. B and C only d. B, D and E only

89. Given below are two statements: one is labelled as Asserti... (A) and the other is labelled as Reason (R). *(20...*
Assertion (A): All vertebrates are chordates but all chordat... are not vertebrates.
Reason (R): Notochord is replaced by vertebral column i... the adult vertebrates
In the light of the above statements, choose the corre... answer from the options given below.
a. (A) is not correct but (R) is correct
b. Both (A) and (R) are correct and (R) is the corr... explanation of (A)
c. Both (A) and (R) are correct but (R) is not the corr... explanation of (A)
d. (A) is correct but (R) is not correct

90. Which of the following statements are true for the phylum-Chordata? *(2020)*
a. In Urochordata notochord extends from head to tail and it is present throughout their life.
b. In Vertebrata notochord is present during the embryonic period only.
c. Central nervous system is dorsal and hollow.
d. Chordata is divided into 3 subphyla:
Hemichordata, Tunicata and Cephalchordata.

91. All vertebrates are chordates but all chordates are not vertebrates, why? *(2020-Covid)*
a. Ventral hollow nerve cord remains throughout life in some chordates
b. all chordates possess vertebral column
c. All chordates possess notochord throughout their life
d. Notochord is replaced by vertebral column in adult of some chordates

92. An important characteristic that hemichordates share with chordates is: *(2017-Delhi)*
a. Absence of notochord
b. Ventral tubular nerve cord
c. Pharynx with gill slits
d. Pharynx without gill slits

93. Select the taxon mentioned that represents both marine and fresh water species: *(2014)*
a. Cnidaria b. Echinoderms
c. Ctenophora d. Cephalochordata

94. Which one of the following statements is totally wrong about the occurrence of notochord while the other three are correct? *(2011 Mains)*
a. It is absent throughout life in humans from the very beginning
b. It is present throughout life in *Amphioxus*
c. It is present only in larval tail in *Ascidians*
d. It is replaced by a vertebral column in adult frog

95. Which is matched with two general characteristics? [MR*] *(2008)*
a. Echinodermata – Pentamerous radial symmetry, internal fertilisation
b. Mollusca – Normally oviparous and development through a trochophore or veliger larva.
c. Arthropoda – Body divisible into head, thorax and abdomen, only tracheal respiration
d. Chordata – Notochord at some stage, separate anal and urine apertures

96. Which one is correctly matched? *(2008)*
a. Scorpion, Spider, Cockroach – Ventral solid central nervous system
b. Cockroach, *Locust*, *Taenia* – Metameric segmentation
c. Liver fluke, Sea Anemone, Sea Cucumber –Bilateral symmetry
d. Centipede, Prawn, Sea Urchin – Jointed appendages

97. What is the true about *Nereis*, Scorpion, Cockroach and Silver Fish? *(2007)*
a. All possess dorsal heart
b. None is aquatic
c. They belong to same phylum
d. They have jointed paired appendages

98. Pick up the matching pair of body feature and animal possessing it: *(2007)*
a. Ventral central nervous system-*Leech*
b. Ventral heart-*Scorpion*
c. Post anal tail-*Octopus*
d. Pharyngeal gill slits absent in embryo-*Chameleon*

99. In which of the following animal post anal tail is found? *(2001)*
a. Earthworm b. Lower invertebrate
c. Scorpion d. Snake

100. Which of the following character is not found in all the chordates? *(2000)*
a. Diaphragm b. Coelom
c. Pharyngeal gill clefts d. Dorsal nerve cord

101. A common characteristic of all vertebrates without exception is: *(1994)*
a. The division of body into head, neck, trunk and tail
b. Their body covered with an exoskeleton
c. The possession of two pairs of functional appendages
d. The presence of well-developed skull

102. What is common in whale, bat and rat? *(1993)*
a. Absence of neck
b. Muscular diaphragm between thorax and abdomen
c. Extra-abdominal testes to avoid high temperature of body
d. Presence of external ears

103. A chordate character is: *(1989)*
a. Gills b. Spiracles
c. Post-anal tail d. Chitinous exoskeleton

Class Cyclostomata, Chondrichthyes, Osteichthyes

104. Select the incorrect statements with respect to Cyclostomes. *(2022 Re)*
A. They lack scales and paired fins.
B. They have circular mouth with jaws.
C. They bear 6-15 pairs of gills.
D. They migrate to deep sea for spawning.
Choose the most appropriate answer from the options given below:
a. (A) and (D) only b. (A) and (B) only
c. (B) and (C) only d. (B) and (D) only

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105. Match the following columns and select the correct option. [MR*] *(2020)*

Column-I		Column-II	
(A)	6-15 pairs of gill slits	(i)	*Trygon*
(B)	Heterocercal caudal fin	(ii)	*Cyclostomes*
(C)	Air bladder	(iii)	*Chondrichthyes*
(D)	Poison sting	(iv)	*Osteichthyes*

	A	B	C	D
a.	(iii)	(iv)	(i)	(ii)
b.	(iv)	(ii)	(iii)	(i)
c.	(i)	(iv)	(iii)	(ii)
d.	(ii)	(iii)	(iv)	(i)

106. A jawless fish, which lays eggs in freshwater and whose ammocoetes larvae after metamorphosis return to the ocean is: *(2015 Re)*

a. *Myxine* b. *Neomyxine*
c. *Petromyzon* d. *Eptatretus*

107. A marine cartilaginous fish that can produce electric current is: *(2014)*

a. *Scoltodon* b. *Pristis*
c. *Torpedo* d. *Trygon*

108. Which one pair comprises jawless fishes? *(2009)*

a. *Mackerels* and *Rohu*
b. *Lampreys* and Hag Fishes
c. *Lampreys* and Eels
d. Guppies and Hag fishes

109. In which of the following notochord is present in embryonic stage? *(2002)*

a. All chordates b. Some chordates
c. Vertebrates d. Non chordates

110. Which fish selectively feed on larva of mosquito? *(2001)*

a. *Gambusia* b. *Rohu*
c. *Clarias* d. *Exocoetus*

Class Amphibia, Reptilia, Aves, Mammalia

111. The unique mammalian characteristics are: *(2023)*

a. pinna, monocondylic skull and mammary glands
b. hairs, tympanic membrane and mammary glands
c. hairs, pinna and mammary glands
d. hairs, pinna and indirect development

112. Which of the following animals has three chambered heart? *(2022 Re)*

a. *Pteropus* b. *Scoliodon*
c. *Hippocampus* d. *Chelone*

113. In which of the following ... additional chambers like crop and gizzard? ...

a. *Pavo, Psittacula, Corvus*
b. *Corvus, Columba, Chameleon*
c. *Bufo, Balaenoptera, Bangarus*
d. *Catla, Columba, Crocodilus*

114. Which one of the following organisms bears hollow pneumatic long bones?

a. *Hemidactylus* b. *Macropus*
c. *Ornithorhynchus* d. *Neophron*

115. Match the following columns and select the correct ... *(2020-Co...*

Column-I		Column-II
(A)	*Apteryx*	(i) Flying fox
(B)	*Pteropus*	(ii) Angel fish
(C)	*Pterophyllum*	(iii) Lamprey
(D)	*Petromyzon*	(iv) Penguin

	A	B	C	D
a.	(iii)	(iv)	(i)	(ii)
b.	(iv)	(i)	(ii)	(iii)
c.	(ii)	(i)	(iv)	(iii)
d.	(iii)	(iv)	(ii)	(i)

116. Match the following group of organisms with their respective distinctive characteristics and select the correct ... [MR*] *(2020-Co...*

Organisms		Characteristics
(A)	Platyhelminthes	(i) Cylindrical body with no segmentation
(B)	Echinoderms	(ii) Warm blooded animals with direct development
(C)	Hemichordates	(iii) Bilateral symmetry with incomplete digestive system
(D)	Aves	(iv) Radial symmetry with indirect development

	A	B	C	D
a.	(ii)	(iii)	(iv)	(i)
b.	(iv)	(i)	(ii)	(iii)
c.	(i)	(ii)	(iii)	(iv)
d.	(iii)	(iv)	(i)	(ii)

117. Which one of these animals is not a homeotherm? *(201...*

a. *Macropus* b. *Chelone*
c. *Camelus* d. *Psittacula*

118. Identify the vertebrate group of animals characterised ... crop and gizzard in its digestive system. *(201...*

a. Amphibia b. Reptilia
c. Aves d. Osteichthyes

119. Which among these is the correct combination of aquatic mammals? *(2017-Delhi)*

a. Seals, Dolphins, Sharks b. Dolphins, Seals, Trygon
c. Whales, Dolphins, Seals d. Trygon, Whales, Seals

120. Which of the following represents order of 'Horse'? [OS] *(2017-Delhi)*

a. Equidae b. Perissodactyla
c. Caballus d. Ferus

121. Choose the correct statement: *(2016 - II)*

a. All reptiles have a three-chambered heart.
b. All pisces have gills covered by an operculum.
c. All mammals are viviparous.
d. All cyclostomes do not possess jaws and paired fins.

122. Which one of the following characteristic is not shared by birds and mammals? *(2016 - I)*

a. Ossified endoskeleton b. Breathing using lungs
c. Viviparity d. Warm blooded nature

123. Which of the following characteristic features always holds true for the corresponding group of animals? *(2016 - I)*

a.	Cartilaginous endoskeleton	Chondrichthyes
b.	Viviparous	Mammalia
c.	Possess a mouth with an upper and a lower jaw	Chordata
d.	3-chambered heart with one incompletely divided ventricle	Reptilia

124. Which is the National Aquatic Animal of India? [OS] *(2016 - I)*

a. Gangetic shark b. River dolphin
c. Blue whale d. Sea-horse

125. Which of the following animals is not viviparous? *(2015)*

a. Platypus b. Whale
c. Flying fox (bat) d. Elephant

126. Which of the following represents the correct combination without any exception? *(2015)*

	Characteristics	Class
a.	Sucking and circular mouth; jaws absent, integument without scales; paired appendages	Cyclostomata
b.	Body covered with feathers; skin moist and glandular; fore-limbs form wings; lungs with air sacs	Aves
c.	Mammary glands; hair on body; pinnae; two pairs of limbs	Mammalia
d.	Mouth ventral; gills without operculum; skin with placoid scales, persistent notochord	Chondrichthyes

127. Match the name of the animal (Column-I) with one characteristics (Column-II) and the phylum/class (Column -III) to which it belongs: [MR*] *(2013)*

	Column-I	Column-II	Column-III
a.	*Adamsia*	Radially symmetrical	Porifera
b.	*Petromyzon*	Ectoparasite	Cyclostomata
c.	*Ichthyophis*	Terrestrial	Reptilia
d.	*Limulus*	Body covered by chitinous exoskeleton	Pisces

128. Which one of the following categories of animals, is correctly described with no single exception in it? *(2012)*

a. All reptiles possess scales, have a three chambered heart and are cold blooded (poikilothermal)
b. All bony fishes have four pairs of gills and an operculum on each side
c. All sponges are marine and have collared cells
d. All mammals are viviparous and possess diaphragm for breathing

129. Which one of the following pairs of animals are similar to each other pertaining to the feature stated against them? *(2012)*

a. *Pteropus* and *Ornithorhynchus*-Viviparity
b. Garden lizard and Crocodile-Three chambered heart
c. *Ascaris* and *Ancylostoma*-Metameric segmentation
d. Sea horse and Flying fish-Cold blooded (poikilothermal)

130. What will you look for to identify the sex of the following? [MR*] *(2011 Pre)*

a. Male shark: Claspers borne on pelvic fins
b. Female *Ascaris*: Sharply curved posterior end
c. Male frog: A copulatory pad on the first digit of the hind limb
d. Female cockroach: Anal cerci

131. Which one of the following groups of animals is correctly matched with its one characteristic feature without even a single exception? *(2011 Pre)*

a. Mammalia: Give birth to young ones
b. Reptilia: Possess 3-chambered heart with one incompletely divided ventricle
c. Chordata: Possess a mouth provided with an upper and a lower jaw
d. Chondrichthyes: Possess cartilaginous endoskeleton

132. In which one of the following the genus name, its two characters and its class/phylum are correctly matched? *(2011 Pre)*

	Genus Name	Two characters	Class/ Phylum
a.	*Aurelia*	(a) Cnidoblasts (b) Organ level of organisation	Coelenterate
b.	*Ascaris*	(a) Body segmented (b) Males and females distinct	Annelida
c.	*Salamandra*	(a) A tympanum represents ear (b) Fertilisation is external	Amphibia
d.	*Pteropus*	(a) Skin possesses hair (b) Oviparous	Mammalia

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133. Crocodile and penguin are similar to whale and dog fish in which one of the following characters? *(2010 Mains)*
a. Possess bony skeleton
b. Possess a solid single stranded central nervous system
c. Have gill slits at some stage
d. Lay eggs and guard them till they hatch

134. Which one of the following statements about all the four of *Spongilla*, leech, dolphin and penguin is correct? [MR*] *(2010 Pre)*
a. Leech is fresh water while all others are marine
b. *Spongilla* has special collar cells choanocytes not found in the remaining three
c. All are bilaterally symmetrical
d. Penguin is homoeothermic while the remaining three are poikilothermic

135. Which avian feature indicates reptilian ancestry? *(2008)*
a. Two special chambers, crop and gizzard in digestive tract
b. Eggs with calcareous shells
c. Scales on hind limbs
d. Four chambered heart

136. What is common among parrot, platypus and kangaroo? *(2007)*
a. Toothless jaws b. Functional post anal tail
c. Oviparity d. Homeothermy

137. They give birth to young ones: *(2006)*
a. Kangaroo, Hedgehog, Dolphin, *Loris*
b. Lion, Bat, Whale, Ostrich
c. Platypus, Penguin, Bat, Hippopotamus
d. Shrew, Bat, Cat, Kiwi

138. Which one of the following characters is not typical of the class Mammalia? *(2005)*
a. Thecodont dentition b. Alveolar lungs
c. Ten pairs of cranial nerves d. Seven cervical vertebrae

139. One of the following is a very unique feature of the mammalian body: *(2004)*
a. Presence of diaphragm b. Four chambered heart
c. Rib cage d. Homeothermy

140. Which one of the following is a matching pair of an animal and a certain phenomenon it exhibits? [MR*] *(2003)*
a. *Pheretima* – Sexual dimorphism
b. *Musca* – Complete metamorphosis
c. *Chameleon* – Mimicry
d. *Taenia* – Polymorphism

141. What is true for mammalia? *(2000)*
a. Platypus is oviparous
b. Bats have feather
c. Elephant is ovo-viviparous
d. Diaphragm is absent in them

142. Hollow air filled bones (pneumatic bones) occur in: *(1999)*
a. Mammals b. Reptiles
c. Urodela d. Aves

143. Pneumatic bone is found in:
a. Shark b. *Rana*
c. Pigeon d. Whale

144. Which of the following is common among mam
a. They undergo no moulting
b. They have seven cervical vertebrae
c. They are carnivores
d. They have ventral nerve cord

145. Which is common between ostrich, penguin and
a. Running birds b. Migratory birds
c. Flightless birds d. Four toed birds

146. Trachea of cockroach and mammal are similar in ha
a. Paired nature b. Non-collapsible walls
c. Ciliated inner lining d. Origin from head

147. Bull Frog of India is: [OS]
a. *Rana tigrina* b. *R. sylvatica*
c. *R. catesbeiana* d. *R. esculenta*

148. Sound box of birds is called: [OS]
a. Pygostyle b. Larynx
c. Syrinx d. Synsacrum

149. An egg laying mammal is:
a. Kangaroo b. Platypus
c. Koala d. Whale

150. Penguin occurs in:
a. Australia b. Antarctica
c. Africa d. America

151. Eutherians are characterised by: [OS]
a. Hairy skin b. True placentation
c. Ovoviviparity d. Glandular skin

152. Wish bone of birds is from: [OS]
a. Pelvic girdle b. Skull
c. Hind limbs d. Pectoral girdle/clavicles

153. Flight muscles of bird are attached to: [OS]
a. Clavicle b. Keel of sternum
c. Scapula d. Coracoid

154. Hair occur in all mammals except those of: [OS]
a. Rodentia b. Chiroptera
c. Primata d. Cetacea

155. Bird vertebrae are: [OS]
a. Acoelous b. Heterocoelous
c. Amphicoelous d. Procoelous

156. Feet of kingfisher are modified for: [OS]
a. Wading b. Perching
c. Running d. Catching

157. Both male and female pigeons secrete milk through: [OS]
a. Salivary glands b. Modified sweat glands
c. Crop d. Gizzard

158. *Typhlops* is: [OS] *(1988)*
a. Sea snake b. Glass snake
c. Blind snake d. Grass snake

159. *Necturus* is: [OS] *(1988)*
a. Hell bender b. Congo eel
c. Mud puppy d. Blind worm

160. Fire bellied toad is: [OS] *(1988)*
a. *Amphiuma* b. *Bombina*
c. *Necturus* d. *Salamandra*

161. Which is not a true amphibian animal? [OS] *(1988)*
a. Salamander b. Toad
c. Tortoise

Answer Key

1. (a)	2. (a)	3. (d)	4. (d)	5. (c)	6. (d)	7. (a)	8. (a)		
11. (a)	12. (a)	13. (c)	14. (c)	15. (b)	16. (c)	17. (b)	18. (d)	19. (c)	20. (b)
21. (a)	22. (b)	23. (b)	24. (b)	25. (d)	26. (c)	27. (d)	28. (b)	29. (c)	30. (a)
31. (b)	32. (d)	33. (a)	34. (b)	35. (a)	36. (a)	37. (a)	38. (c)	39. (a)	40. (b)
41. (a)	42. (d)	43. (d)	44. (b)	45. (b)	46. (c)	47. (a)	48. (a)	49. (b)	50. (a)
51. (c)	52. (a)	53. (a)	54. (c)	55. (d)	56. (d)	57. (b)	58. (d)	59. (b)	60. (d)
61. (d)	62. (a)	63. (d)	64. (d)	65. (a)	66. (c)	67. (d)	68. (d)	69. (a)	70. (a)
71. (c)	72. (a)	73. (d)	74. (d)	75. (a)	76. (a)	77. (d)	78. (b)	79. (b)	80. (c)
81. (c)	82. (a)	83. (a)	84. (d)	85. (b)	86. (b)	87. (c)	88. (c)	89. (b)	90. (c)
91. (d)	92. (c)	93. (a)	94. (a)	95. (b)	96. (a)	97. (a)	98. (a)	99. (d)	100. (a)
101. (d)	102. (b)	103. (c)	104. (d)	105. (d)	106. (c)	107. (c)	108. (b)	109. (a)	110. (a)
111. (c)	112. (d)	113. (a)	114. (d)	115. (b)	116. (d)	117. (b)	118. (c)	119. (c)	120. (b)
121. (d)	122. (c)	123. (a)	124. (b)	125. (a)	126. (a)	127. (b)	128. (b)	129. (d)	130. (a)
131. (d)	132. (c)	133. (c)	134. (b)	135. (c)	136. (d)	137. (a)	138. (c)	139. (a)	140. (b)
141. (a)	142. (d)	143. (c)	144. (a)	145. (c)	146. (b)	147. (a)	148. (c)	149. (b)	150. (b)
151. (b)	152. (d)	153. (b)	154. (d)	155. (b)	156. (a)	157. (c)	158. (c)	159. (c)	160. (b)
161. (c)									

Explanations

1. (a) Platyhelminthes are bilaterally symmetrical, triploblastic and acoelomate animals with organ level of organisation.

2. (a) True segmentation is present in phylum Annelida, Arthropoda and Chordata. They also have organ system level of organisation, bilateral symmetry and are true coelomates.

3. (d) Sponges, corals (Coelenterate) and ctenophores are diploblastic.

4. (d) Aschelminthes are bilaterally symmetrical, triploblastic and acoelomate organisms.

5. (c) Body cavity which is lined by mesoderm, is called coelom.

6. (d) Metamerism is usually occurs in three highly organised phyla: Annelida, Arthropoda and Chordata.

7. (a) All the animals belonging to cnidaria (e.g., jellyfish) and enchinodermata (e.g. starfish) are radially symmetrical. These organisms are attached to the substratum.

8. (a) Roundworms have a body cavity called pseudocoelom consisting of a fluid-filled space between the body wall and digestive tract. Pseudocoelom is derived from the blastocoel of the embryo rather than from a secondary cavity within the embryonic mesoderm (which results in a true body cavity or coelom).

9. (b) (B), (C) and (D) only
Ctenophores, or comb jellies reproduce only through sexual means, with external fertilisation. Platyhelminthes are triploblastic, acoelomate, not pseudocoelomate, and exhibit bilateral symmetry. In tapeworms (a type of Platyhelminth), fertilisation is internal and is hermaphroditic. In sponges, fertilisation is internal and development is indirect.

10. (c) Spongocoel (body cavity) and canals are lined with choanocytes (collar cells).

11. (a) *Trichinella spiralis* is an endoparasitic worm in the intestine of human beings. It is viviparous. The disease caused by *Trichinella spiralis* is called trichinosis. The symptoms include diarrhoea, nausea, abdominal pain, muscular pain, etc.

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12. (a) Some cnidarians which exist in both forms of body namely polyp and medusa exhibits alternation of generation (metagenesis).

13. (c) *Planaria* possess high capacity of regeneration.

14. (c) Platyhelminthes has incomplete digestive system. Mouth serves as common passage for ingestion and excretion.

15. (b) *Ascaris* (Aschelminthes) are triploblastic, pseudocoelomates and bilateral symmetrical.

16. (c) *Ctenoplana* and *Beroe* does not posses cnidoblasts and they have biradial symmetry.

17. (b) *Sycon* is an example of phylum Porifera. Members of this phylum are primitive multicellular animals and show cellular level of organisation.

18. (d) *Hydra* does not have a recognisable brain or true muscles. Nerve nets connect sensory photoreceptors and touch-sensitive nerve cells located in body wall and tentacles.

19. (c) For excretion, there are no specialised structures in *Hydra*. They have a single opening called mouth on hypostome. Carbon dioxide, salts and ammonia leave the cells by diffusion into iso-osmotic surroundings.

20. (b) Members of coelenterata and ctenophora show tissue-level of organisation, e.g., *Hydra*, sponges exhibit cellular-grade of organisation. Liver fluke and *Ascaris* shown organ and organ-system level of organisation.

21. (a) Cnidarians exhibit two basic body forms-sessile polyp (e.g., *Hydra*) and free-swimming medusa (e.g *Aurelia*). Some cnidarians, such as *Obelia*, show alternation of generation or metagenesis, i.e., polyps produce medusae asexually and medusae form polyps sexually.

22. (b) *Ascaris* lay embryonated eggs, viz-eggs having an embryo. These embryonated eggs are ingested and hatch in stomach and duodenum, from where the larvae penetrate the intestinal wall. So, these eggs carry embryo in a juvenile stage.

23. (b) Sponges are asymmetrical. They are mostly marine but can also be found in fresh water. Regenerative power of sponges is high.

24. (b) Nephridia in earthworm helps in osmoregulation & excretion. Same function in *Planaria* is performed by specialised cells called flame cells.

25. (d) Sponges have a water canal system. Water enters through minute pores (ostia) in body wall to a central cavity spongocoel.

26. (c) Polyp forms of phylum coelenterata are sessile and show radial symmetry.

27. (d) Nematocysts are specialised cell in tentacles of coelenterate, containing a barbed or venomous coiled thread that is projected in self-defence or to capture prey.

28. (b) *Schistosoma* are commonly known as blood-flukes. They are parasitic flatworms responsible for a group of infections in humans termed schiostosomiasis.

29. (c) *Taenia saginata* has close resemblance to other tapeworms *(T. solium)* except for few details such as it is larger, has more proglottids and lacks rostellar hooks.

30. (a) *Hydra* does not have a recognisable brain-nerve nets connect sensory photoreceptors & touch-sensitive nerve cells.

31. (b) In *Ascaris*, rhabditiform larva of first stage is not infective.

32. (d) Proglottides are segments in the strobila of a tapeworm, containing a complete sexually mature reproduction system.

33. (a) Ascon type of canal system is the simplest of all the three. Water current flows as: Ingressing water → Ostia → Spongocoel → Osculum → Outside.

34. (b) The body of Poriferans is supported by a skeleton made up of spicules or spongin fibres. The classification of phylum Porifera is based upon the presence and composition of spicules.

35. (a) There are specialised cells found in flatworms which helps in maintaining osmotic balance and excretion, these are called as flame cells.

36. (a) Cysticercus is a larval tapeworm at a stage in which the scolex is inverted in a sac. It is typically found encysted in muscle tissue of the host.

37. (a) *Taenia saginata* is very similar to *Taenia solium*, except for few differences. *T.saginata* is larger than *T.solium* and *T. saginata* has more proglottids, more testis. Rostellum in *T. solium* is armed with two rows of spiny hooks whereas these scolex hooks are absent in *T.saginata*.

38. (c) Oncosphere is the larval form of a tapeworm (genus *Taenia*), once it has been ingested by an intermediate host animal.

39. (a) Oncosphere is larval form of tapeworms. These larval forms are ingested by secondary host or humans.

40. (b) Jelly fish are free - swimming aquatic animals lie under kingdom Cnidaria and class Scyphozoa.

41. (a) The common name of *Tubipora* is organ pipe coral.

42. (d) Flatworms (e.g., *Taenia*) have excretory systems called protonephridia with flame cells.
Freshwater *Paramoecium* have osmoregulatory organelle called contractile vacuole. Urecose glands in Cockroaches (*Periplaneta*) helps in excretion. In earthworms (*Pheretima*), the excretory organs are nephridia.

43. (d) A-(II), B-(I), C-(III), D-(IV)
(A) Contractile vacuole - (II) *Amoeba*
(B) Water vascular system - (I) *Asterias*
(C) Canal system - (III) *Spongilla*
(D) Flame cells - (IV) *Taenia*

44. (b) Metamerism is commonly observed in the members of phylum Annelida where the body is externally and internally divided into segments with a serial repetition of atleast some organs.
Water transport or canal system is present in the members of phylum Porifera.
The body of ctenophores bears eight external rows of ciliated comb plates which help in locomotion.
Cnidoblasts or cnidocytes are present on the tentacles and the body of the members of phylum Coelenterata (Cnidaria).

45. (b) *Physalia* – Portuguese man of war
Limulus – Living fossil
Ancylostoma – Hookworm
Pinctada – Pearl oyster

46. (c) Metagenesis, i.e., alternation of generation, is observed in members of phylum Coelenterata (Cnidaria).
Comb plates present in ctenophores and help in locomotion.

47. (a) Locusta – Gregarious, polyphagous pest.
Echinoderms (*Asterias*) – Adults with radial symmetry and larvae larva with bilateral symmetry
Scorpions – Respiration takes place through book lungs
Ctenophores (*Ctenoplana*) – Bioluminescence is well marked feature

48. (a) Annelida exhibit organ-system level of body organisation and bilateral symmetry. They are triploblastic, metamerically segmented and coelomate animals.

49. (b) *Pila is a* mollusc. The mouth contains a file - like rasping organ for feeding called radula.
Bombyx is an arthropod. In *Bombyx*, excretion takes place through Malpighian tubules.
Pleurobrachia is a ctenophore. Their body bears eight external rows of ciliated comb plates, which help in locomotion.
Taenia is a platyhelminth. It has specialised cells called flame cells which helps in osmoregulation and excretion.

50. (a) Development is direct in annelids, so there is no larval stage in earthworms.

51. (c) Phylum-Arthropoda has all the given three characters except parapodia.
Nereis (an Annelid) possess lateral appendages, parapodia, which help in swimming.

52. (a) Most distinctive characteristics of arthropoda is their exoskeleton containing chitin, mucopolysaccharides. The success of arthropods is related to their hard exoskeleton which serves as purpose of forming an armor against enemies, protection against desiccation in different types of habitats.

53. (a) Sponges usually have a skeleton consisting of spicules (may be calcareous or silicious) or spongin fibres. The cavity common to all sponges is spongocoel or paragastric cavity lined by flagellated choanocytes.

54. (c) Silverfish belongs to phylum Arthropoda.

55. (d) Housefly, butterfly, tsetse fly and silverfish belongs to phylum Arthropoda and class Insecta.

56. (d) Prawn, scorpion, *Locusta* belong to same phylum Arthropods.

57. (b) C (octopus) is an example of Mollusca and D (scorpion) is an example of arthropoda. They have a true coelom.

58. (d) Mollusca and insects are coelomates, flatworms are acoelomate while roundworms are pseudocoelomates.

59. (b) Annelids are coelomates, triploblastic and bilaterally symmetrical. They have clitellum. They are metamerically segmented.

60. (d) *Pila globosa* – Pearl is mismatch. Pearl is produced by *Pinctada oyster.*

61. (d) Porifera – *Spongilla, Euplectella* (*Pennatula* → Coelenterate)
Cnidaria – *Physalia, Aurelia* (*Bonellia* → Annelida)
Platyhelminthes – *Planaria, Schistosoma* (*Enterobius* → Aschelminthes)

62. (a) All of them have jointed legs and chitinous exoskeleton.

63. (d) Annelida and arthropoda have metameric segmentation.

64. (d) Poriferans are not exclusively marine (*Spongilla* – fresh water sponges).

65. (a) Platyhelminthes are triploblastic, bilateral symmetrical, acoelomate organisms.

66. (c) Adult Echinoderms are radially symmetrical but larvae are bilaterally symmetrical.

67. (d) Arthropoda is the largest phylum of Animalia & includes insects majorly. In insects, the body is divided into 3 regions-head, thorax & abdomen.

68. (d) Haemocyanin is a protein which transport oxygen in the bodies of some invertebrates. Unlike hemoglobin in RBCs of vertebrates, haemocyanin are not bound to blood cells. They are found only in mollusca and Arthropoda.

69. (a) Solenocytes are flagellated cells associated with excretion and osmoregulation. These are the cells which form subtypes of protonephridium along with flame cells. Solenocytes of platyhelminthes are analogous to nephridium of annelids.

70. (a) Arthropods have jointed appendages. Sensory organs like antennae, eyes (compound or simple), statocysts or balance organs are present.

71. (c) Tapeworm is an endoparasite and mosquito and leech are blood-parasite in human beings. *Adamsia* or sea anemone is non-parasitic coelenterata.

72. (a) Tube feet are active tubular projections on oral surface of Echinoderms that are a part of water vascular system.

73. (d) The looping and crawling movement in *Hirudinaria* is perform with the help of muscles and suckers which serve for attachment.

74. (d) Development is indirect in butterfly, mosquito and frog, all of them possess larva that undergo metamorphosis to form a new adult individual.

75. (a) Mount of sea urchin (Echinoidea) has a complex dental apparatus called *Aristotle's* lantern, which also may be venomous.

76. (a) *Asterias*, commonly known as star fish belongs to class Asteroidea.

77. (d) Cephalopods are most intelligent, mobile and largest of all molluscs, e.g., octopus. They have advanced vision and can detect gravity with statocyst. Morphological construction gives eyes of cephalopods the same performance as sharks.

78. (b) Body of Adult *Culex* is provided with stouter legs and at rest body lies parallel to the surface. In *Anopheles*, body is provided with delicate legs and body is inclined at an angle of 45° to the surface at rest position.

79. (b) Adult echinoderms are radially symmetrical but larvae are bilaterally symmetrical.

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80. (c) Alternate movement between filthy material and human food makes houseflies mechanical carriers to humans of several pathogens (e.g., viruses, bacteria, protozoa, and helminth eggs) that may cause disease.

81. (c) Ecdysone is a steroid hormone, secreted by a pair of prothoracic glands in the thorax of insects and by Y organs in crustaceans, that stimulates moulting and metamorphosis.

82. (a) In reptiles, the stratum corneum is permanent, and is only replaced during times of rapid growth, in a process called ecdysis or moulting.

83. (a) Malpighian tubule system is a type of excretory and osmoregulatory system found in insects by which excretory products and toxic compounds are transported.

84. (d) *Gambusia* is a fish that feeds on mosquito larvae and is called larvicidal fish. It controls the growth of mosquito in aquatic ecosystem.

85. (b) The common name of *Teredo* is shipworm.

86. (b) The silk is obtained from the cocoons of the larvae of the silkworm. The protein fibre of silk is composed of fibroin.

87. (c) Radial symmetry: When any plane passing through the central axis of the body divides the organism into two identical halves.

Bilateral symmetry: When the body can be divided into identical left and right halves in only one plane.

The adult echinoderms are radially symmetrical but larvae are bilaterally symmetrical.

Coelenterates and Ctenophores are radially symmetrical animals.

Hemichordates are bilaterally symmetrical animals.

88. (c) Phylum Chordata are characterised by the presence of a notochord, a dorsal hollow nerve cord, and paired pharyngeal gill slits. These are triploblastic, coelomate with organ-system level of organisation. Vertebrates have a ventral muscular heart with two, three or four chambers.

89. (b) The members of Vertebrata possess notochord during embryonic development. Therefore, all vertebrates are chordates. However, the notochord gets replaced by a cartilaginous or bony vertebral column in the adult. Therefore, all chordates are not vertebrates.

90. (c) In Urochordata, notochord is present only in larval tail. In Cephalochordata, the notochord extends from head to tail region and is persistent throughout the life. Chordata is divided into 3 subphyla : Vertebrata, Tunicata and Cephalochordata.

91. (d) The members of subphylum Vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult. Thus all vertebrates are chordates but all chordates are not vertebrates.

92. (c) Pharyngeal gill slits are present in hemichordates as well as in chordates. Notochord is present in chordates only. Ventral tubular nerve cord is characteristic feature of non-chordates.

93. (a) Echinoderms, Ctenophora and Cephalochordata are exclusively marine.

94. (a) The notochord is replaced by a cartilaginous or bony vertebral column in the adult humans. Notochord present in embryonic period of human beings.

95. (b) In Echinodermata, fertilisation is external. In Arthropoda, respiratory organs are gills, book gills, book lungs or tracheal system.Chordata are characterised by the presence of notochord.

96. (a) Scorpion, Spider and cockroach are non-chordates; they have ventral solid CNS, dorsal heart.

97. (a) *Nereis*, scorpion, cockroach and silver fish are non - chordates. All of them possess dorsal heart.

98. (a) Non-chordates have ventral nervous system. Dorsal heart and post anal tail is present in chordates.

99. (d) Post anal tail is a characteristic feature of phylum chordates. Sponges (Porifera), earthworm (Annelida) and cockroach (Arthropoda) are non-chrodates while snakes belongs to class Reptilia under sub-phylum vertebrata.

100. (a) Diaphragm is a muscular sheath that supports the lung and helps in respiration. Many chordates, such as fishes and amphibians, do not have lungs & thus diaphragm is not found in them.

101. (d) All vertebrates possess cranium that protect the brain. In cyclostomes & chondrichthyes, it is made up of cartilage and in rest groups bony skull is present.

102. (b) Having a diaphragm to support the base of lungs, is common feature found in mammals.

103. (c) Chordata are fundamentally characterised by the presence of a notochord, a dorsal hollow nerve cord, paired pharyngeal slits (gill-slits) and post-anal tail.

104. (d) Cyclostomes lack scales and paired fins, and they do not have jaws; their mouth is circular and lacks true jaws. They bear 6-15 pairs of gills and migrate to freshwater for spawning, not to the deep sea.

105. (d) Cyclostomes have an elongated body bearing 6-15 pairs of gill slits for respiration.

Bony fishes belonging to class Osteichthyes contains air bladder which regulates buoyancy.

Trygon, a cartilaginous fish, possesses poison sting.

In members of class Chondrichthyes, tail is elongated with heterocercal caudal fin (the upper and lower halves of unequal size.

106. (c) *Cyclostomata* class comprises of jawless vertebrate. They are marine but migrate for spawning to fresh water. E.g., *Petromyzon*.

107. (c) *Torpedo* have electric organs to produce electric current.

108. (b) Cyclostomata comprises of jawless fish. Living members of Cyclostomata are Ectoparasite on fish. *E.g.*, Lamprey's and Hag fish.

109. (a) All animals belonging to phylum chordata are fundamentally characterised by presence of notochord. In larval or embryonic stage, all members of this phylum exhibit notochord whereas in adults notochord may be absent (as in urochordata) or may be modified into vertebrae (as in subphylum vertebrata).

110. (a) *Gambusia* is a freshwater fish. They are viviparous-give birth to live young. These fishes are introduced into ponds to eat mosquito larvae.

111. (c) The most unique mammalian characteristic is the presence of mammary gland (milk producing glands), skin possessing hair and presence of external ear or pinnae.

112. (d)

Animal	Class	Heart chambers
Pteropus (Flying fox)	Mammalia	Four
Scoliodon (Dog fish)	Chondrichthyes (Pisces)	Two
Hippocampus (Sea horse)	Osteichthyes (Pisces)	Two
Chelone	Reptile	Three

113. (a) The digestive tract of birds has additional chambers, the crop and gizzard. Examples: *Corvus* (Crow), *Columba* (Pigeon), *Psittacula* (Parrot), *Struthio* (Ostrich), *Pavo* (Peacock), *Aptenodytes* (Penguin), *Neophron* (Vulture).

114. (d) *Neophron* (vulture) belongs to class Aves. Endoskeleton of the members of class Aves is fully ossified (bony) and the long bones are hollow with air cavities (pneumatic).

Hemidactylus (Wall lizard) belongs to class Reptilia.

Macropus (Kangaroo) belongs to class Mamma

115. (b) *Pteropus* – Flying fox

Petromyzon – Lamprey

Aptenodytes – Penguin

Pterophyllum – Angel fis

116. (d) Platyhelminthes are bi and acoelomate animals with organ level of organisation.

The adult echinoderms are radially symmetrical but larvae are bilaterally symmetrical. Development is indirect with free-swimming larva.

The body of Hemichordates is cylindrical and is composed of an anterior proboscis, a collar and a long trunk.

Aves are warm-blooded animals with direct development.

117. (b) Reptilians are poikilothermic, i.e., their body temperature varies according to climate, e.g., *Chelone*.

118. (c) Birds swallow food and store it in their crop. Then the food passes into stomach and then into gizzard which can grind the food with previously swallowed stones.

119. (c) Sharks and *Trygon* (sting ray) are the members of chondrichthyes (cartilaginous fish) while whale, dolphin and seals are aquatic mammals belong to class mammalia.

120. (b) Horse belongs to

Order: *Perissodactyla*

Family: *Equidae*

Genus: *Equus*

Species: *E. ferus*

121. (d) *Cyclostomes* have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins.

All reptiles have a three-chambered heart except crocodiles (4 chambered).

All mammals are viviparous except platypus.

122. (c) Birds are oviparous and development is direct.

Mammals are viviparous except oviparous-*Ornithorhynchus*.

123. (a) Chondrichthyes are marine animals with streamlined body and have cartilaginous endoskeleton.

124. (b) National Aquatic Animal of India is river dolphin (*Platanista gangetica*); exclusively found in freshwater or brackish water.

125. (a) *Ornithorhynchus* (Platypus) is an oviparous mammal.

126. (a) Cyclostomata have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins.

127. (b) *Petromyzon* is ectoparasite and belong to class cyclostomata.

128. (b) All bony fishes have four pair of gills and an operculum on each side.

129. (d) Both are fishes and cold blooded animals.

130. (a) Male shark-Claspers borne on pelvic fins.

131. (d) All Chondrichthyes possess cartilaginous endoskeleton without exception.

132. (c) • *Aurelia* belongs to phylum coelenterata in which tissue level of organisation is present.

• *Ascaris* belongs to phylum Aschelminthes.

• *Pteropus* is viviparous.

133. (c) Crocodile and penguin have gill slits at embryonic stage.

134. (b) Choanocytes are the characteristics of sponges which are absent in leech, dolphin and penguin.

135. (c) Aves have scales on hindlimb that indicates reptilian ancestry.

136. (d) Toothless jaws → Parrot

Functional post anal tail → *Platypus*

Oviparity → Parrot, *Platypus*

137. (a) Viviparous – Kangaroo, Hedgehog, Dolphin, *Loris*

Oviparous – Ostrich, *Platypus*, Kiwi

138. (c) Mammalia has 12 pairs of cranial nerves.

139. (a) Mammals have diaphragms and other vertebrates such as amphibians & reptiles have diaphragm - like structures. Aves do not have diaphragm. Four - chambered heart is also found in crocodile & aves, therefore, it is not unique to mammals.

140. (b) Metamorphosis is striking change of form / structure in an individual after hatching or birth. Housefly has complete metamorphosis with distinct egg, larval, pupal & adult stages. *Pheretima* is hermaphrodite (bisexual). *Chameleon* exhibits camouflage. *Taenia saginata* does not show polymorphism.

141. (a) Bats have skin-folded wings. Elephant is completely viviparous, i.e., it gives birth to young ones. All members of mammalia respire through lungs and lungs are subtended in thoracic cavity by a muscular diaphragm. Platypus, a mammal, show exception and is an oviparous animal.

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142. **(d)** In Aves, endoskeleton is fully ossified and long bones are hollow with air cavities. These pneumatic bones are modification to decrease the weight of body & facilitate smooth flight.

143. **(c)** Pneumatic (hollow) long bones are characteristic feature of class Aves.

144. **(a)** Development in mammals is always direct so members of mammalia do not undergo moulting.

145. **(c)** All of these organisms belongs to Aves but can't fly and therefore called as flightless birds.

146. **(b)** Respiratory organs of cockroach includes tracheal system like human beings. Trachea is wind pipe through which gases are transported to lungs. They need to be make up of non-collapsible walls as collapse of this tube may lead to death of organism.

147. **(a)** *Rana tigrina (Hoplobatrachus tigerinus)*, the Indus valley bullfrog is a large species of frog found in Myanmar, Bangladesh, India, Pakistan, Afghanistan & Nepal.

148. **(c)** Syrinx is the sound box found in birds. Its analogous in mammals is called larynx.

149. **(b)** Mostly mammals are viviparous but platypus is an exception. It lay eggs and therefore called oviparous.

150. **(b)** Penguins are a group of aquatic, flightless birds living almost exclusively in Antarctica.

151. **(b)** Eutheria is a taxon containing the placental mammals, such as humans.

152. **(d)** Wish bone is the furcula of birds. It is a forked bone constituted by the fused clavicles and articulates to each of the birds's scapulae of pectoral girdle. Its function is to strengthen thoracic skeleton to with stand rigors of flight.

153. **(b)** In birds, the pectoral and supracoracoideus muscles that power the wings are anchored to a large bony keel along the midline of the sternum.

154. **(d)** Order cetacea includes whales, dolphins and porpoises.

155. **(b)** Bird vertebrae are heterocoelous, i.e., the central of vertebrae have saddle-shaped ends.

156. **(a)** In kingfisher, their syndactyly configuration helps in giving them additional support for hours of perching. Their feet are short & they do not walk much but they wade.

157. **(c)** It is formed by the degeneration of the epithelial cells lining the crop.

158. **(c)** *Typhlops* is a genus of blind snakes (non-poisonous snake).

159. **(c)** *Necturus* is a genus of aquatic salamanders. They are commonly known as waterdogs and mud puppies. Their characteristic feature is feathery gills on either side of its head.

160. **(b)** Fire-bellied toads are a group of eight species of small frogs belonging to the genus *Bombina*. Their skin is known to be toxic to some animals including humans.

161. **(c)** *Testudo* (Tortoise) is an example of reptiles. It is a terrestrial animal having dry & cornified skin with epidermal scales on body. Heart is 3-chambered. In this, development is direct unlike amphibians.

CHAPTER 5

Morphology of Flowering Plants

The Root

1. The roots that originate from the base of the stem are: *(2020)*
   a. Primary roots b. Prop roots
   c. Lateral roots d. Fibrous roots
2. Pneumatophores occur in *(2018)*
   a. Halophytes b. Free-floating hydrophytes
   c. Carnivorous plants d. Submerged hydrophytes
3. Sweet potato is a modified *(2018)*
   a. Stem b. Adventitious root
   c. Tap root d. Rhizome
4. Root hairs develop from the region of: *(2017-Delhi)*
   a. Maturation b. Elongation
   c. Root cap d. Meristematic activity
5. Roots play insignificant role in absorption of water in: *(2015 Re)*
   a. *Pistia* b. Pea
   c. Wheat d. Sunflower
6. In a longitudinal section of a root, starting from the tip upward, the four zones occur in the following order: *(2004)*
   a. Root cap, cell division, cell maturation, cell enlargement
   b. Cell division, cell enlargement, cell maturation, root cap
   c. Cell division, cell maturation cell enlargement, root cap
   d. Root cap, cell division, cell enlargement, cell maturation
7. Pneumatophores are found in: *(2000)*
   a. The vegetation which is found in marshy and saline lake
   b. The vegetation which found in saline soil
   c. Xerophytes
   d. Epiphytes
8. The plant having the largest flower is: [OS] *(1999)*
   a. Total stem parasite b. Epiphyte
   c. Total root parasite d. Partial stem parasite
9. Velamen is found in: [OS] *(1991)*
   a. Roots of screwpine
   b. Aerial and terrestrial roots of orchids
   c. Leaves of *Ficus elastica*

The Stem

10. Which of the following statements is not correct? *(2022 Re)*
    a. The rhizome is thick, prostrate and branched
    b. Rhizome is a condensed form of stem
    c. The apical bud in rhizome always remains above the ground
    d. The rhizome is aerial with no distinct nodes and internodes
11. In *Bougainvillea*, thorns are the modifications of: *(2017-Delhi)*
    a. Stipules b. Adventitious root
    c. Stem d. Leaf
12. Stems modified into flat green organs performing the functions of leaves are known as: *(2016 - I)*
    a. Cladodes b. Phyllodes
    c. Phylloclades d. Scales
13. Which of the following is not a stem modification? *(2016 - I)*
    a. Pitcher of *Nepenthes* b. Thorns of *Carissa*
    c. Tendrils of cucumber d. Flattened structures of *Opuntia*
14. An example of edible underground stem is: *(2014)*
    a. Potato b. Carrot
    c. Groundnut d. Sweet potato

The Leaf

15. Identify the correct set of statements: [NEET] *(2022)*
    A. The leaflets are modified into pointed hard thorns in *Citrus* and *Bougainvillea*
    B. Axillary buds form slender and spirally coiled tendrils in cucumber and pumpkin
    C. Stem is flattened and fleshy in *Opuntia* and modified to perform the function of leaves
    D. *Rhizophora* shows vertically upward growing roots that help to get oxygen for respiration
    E. Subaerially growing stems in grasses and strawberry help in vegetative propagation
    Choose the correct answer from the options given below.
    a. A, B, D and E only b. B and C only
    c. A and D only d. B, C, D and E only

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16. Leaves become modified into spines in: *(2015)*
a. Onion b. Silk Cotton
c. *Opuntia* d. Pea

17. Phyllode is present in: *(2012 Pre)*
a. *Opuntia* b. *Asparagus*
c. *Euphorbia* d. Australian acacia

18. Whorled simple leaves with reticulate venation are present in: *(2011 Mains)*
a. China Rose b. *Alstonia*
c. *Calotropis* d. Neem

19. Ability of Venus Fly Trap to capture insects is due to: [OS] *(2005)*
a. Specialised "muscle - like" cells
b. Chemical stimulation by prey
c. Rapid turgor pressure changes
d. Passive process requiring no special ability on the part of the plant

20. Choose the correct match *(2002)*
Bladderwort, sundew, venus-fly trap:
a. *Nepanthese, Dionea, Drosera*
b. *Nepanthese, Utricularia, Vanda*
c. *Utricularia, Drosera, Dionea*
d. *Dionea, Trapa, Vanda*

21. Which pair is of insectivorous plants? *(1999)*
a. *Drosera* and *Vallisneria*
b. *Utricularia* and *Hydrilla*
c. *Aldrovanda* and *Utricularia*
d. *Rafflesia* and *Dionea*

The Inflorescence

22. Given below are two statements: One is labelled as Assertion A and the other is labeled as Reason R: *(2023)*

Assertion A: A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.

Reason R: Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.

In the light of the above statements, choose the correct answer from the options given below:
a. A is false but R is true.
b. Both A and R are true and R is the correct explanation of A.
c. Both A and R are true but R is NOT the correct explanation of A.
d. A is true but R is false.

23. Cymose inflorescence is present in: *(2012 Pre)*
a. *Brassica* b. *Solanum*
c. *Sesbania* d. *Trifolium*

24. Hair found in the inflorescences of *Zea mays* are a modification of: [OS] *(20*
a. Style b. Stigma
c. Spathe d. Filaments

25. Hypanthodium is a specialized type of: [OS] *(19*
a. Fruit b. Inflorescence
c. Thalamus d. Ovary

The Flower

26. Axile placentation is observed in *(20*
a. China rose, Petunia and Lemon
b. Mustard, Cucumber and Primrose
c. China rose, Beans and Lupin
d. Tomato, Dianthus and Pea

27. In *Calotropis*, aestivation is: *(2023-Manipu*
a. Valvate b. Vexillary
c. Imbricate d. Twisted

28. In a pea flower, five petals are arranged in a specialized manner with one posterior, two lateral and two anterior. These are named as ....., ... and ..... respectively. *(2023-Manipu*
a. Keel, Wings and Standard
b. Vexillum, Keel and Standard
c. Keel, Standard and Carina
d. Standard, Wings and Keel

29. Match the following: [MR*] *(2023-Manipu*

Type of flower		Example	
(A)	Zygomorphic	(I)	Mustard
(B)	Hypogynous	(II)	Plum
(C)	Perigynous	(III)	*Cassia*
(D)	Epigynous	(IV)	Cucumber

Select the correct option:
a. A-I, B-II, C-IV, D-III b. A-I, B-II, C-III, D-IV
c. A-IV, B-I, C-III, D-II d. A-III, B-I, C-II, D-IV

30. Match List-I with List-II: [MR*] *(2022 M*

List-I		List-II	
(A)	Imbricate	(I)	*Calotropis*
(B)	Valvate	(II)	*Cassia*
(C)	Vexillary	(III)	Cotton
(D)	Twisted	(IV)	Bean

Choose the correct answer from the options given below
a. A-I, B-II, C-IV, D-II b. A-II, B-I, C-III, D-IV
c. A-II, B-I, C-IV, D-III d. A-II, B-IV, C-III, D-I

31. Which one of the following plants shows vexillary aestivation and diadelphous stamens? *(2022)*
a. *Solanum nigrum* b. *Colchicum autumnale*
c. *Pisum sativum* d. *Allium cepa*

32. The flowers are Zygomorphic in: *(2022)*
A. Mustard B. Gulmohar
C. *Cassia* D. *Datura*
E. Chilli
Choose the correct answer from the options given below.
a. C, D and E only b. A, B and C only
c. B and C only d. D and E only

33. Diadelphous stamens are found in: *(2021)*
a. Citrus b. Pea
c. China rose and citrus d. China rose

34. Ray florets have: *(2020)*
a. Superior ovary b. Hypogynous ovary
c. Half inferior ovary d. Inferior ovary

35. The ovary is half inferior in: *(2020)*
a. Mustard b. Sunflower
c. Plum d. Brinjal

36. Correct position of floral parts over thalamus in mustard plant is- *(2020-Covid)*
a. Margin of the thalamus grows upward, enclosing the ovary completely, and other parts arise below the ovary
b. Gynoecium is present in the centre and other parts cover it partially
c. Gynoecium is situated in the centre, and other parts of the flower are located at the rim of the thalamus, at the same level
d. Gynoecium occupies the highest position, while the other parts are situated below it

37. Placentation in which ovules develop on the inner wall of the ovary or in peripheral part, is *(2019)*
a. Basal b. Axile
c. Parietal d. Free central

38. Free-central placentation is found in: *(2016 - II)*
a. *Brassica* b. *Citrus*
c. *Dianthus* d. *Argemone*

39. Radial symmetry is found in the flowers of: *(2016 - II)*
a. *Pisum* b. *Cassia*
c. *Brassica* d. *Trifolium*

40. How many plants among *Indigofera*, *Sesbania*, *Salvia*, *Allium*, Aloe, mustard, groundnut, radish, gram and turnip have stamens with different lengths in their flowers? *(2016 - II)*
a. Five b. Six
c. Three d. Four

41. The term 'Polyadelphous' is related to: *(2016 - II)*
a. Corolla b. Calyx
c. Gynoecium d. Androecium

42. The standard petal of a papilionaceous corolla is also called: *(2016 - I)*
a. Carina b. Pappus
c. Vexillum d. Corona

43. Perigynous flowers are found in: *(2015)*
a. China rose b. Rose
c. Guava d. Cucumber

44. Ovary is inferior in: *(2015)*
a. *Guava* b. *Rose*
c. *China rose* d. *Peach*

45. Axile placentation is present in: *(2015 Re)*
a. Lemon b. Pea
c. *Argemone* d. *Dianthus*

46. Among china rose, mustard, brinjal, potato, onion and tulip, how many plants have superior ovary? *(2015 Re)*
a. Six b. Three
c. Four d. Five

47. When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as: *(2014)*
a. Valvate b. Vexillary
c. Imbricate d. Twisted

48. Among bitter gourd, mustard, brinjal, pumpkin, china rose, *Lupin*, cucumber, sun hemp, gram, guava, bean, chili, plum, *Petunia*, tomato, rose, *Withania somnifera*, potato, onion, Aloe and tulip how many plants have hypogynous flower? *(2013)*
a. Eighteen b. Six
c. Ten d. Fifteen

49. In China rose the flowers are: *(2013)*
a. Zygomorphic, epigynous with twisted aestivation
b. Actinomorphic, hypogynous with twisted aestivation
c. Actinomorphic, epigynous with valvate aestivation
d. Zygomorphic, hypogynous with imbricate aestivation

50. How many plants in the list given below have marginal placentation? Mustard, Gram, Tulip, Asparagus, Arhar, Sun hemp, Chili, *Colchicine*, Onion, Moong, Pea, Tobacco, *Lupin*: *(2012 Mains)*
a. Four b. Five
c. Six d. Three

51. Placentation in tomato and lemon is: *(2012 Pre)*
a. Axile b. Parietal
c. Free central d. Marginal

52. Which one of the following diagrams represents the placentation in *Dianthus*? *(2011 Mains)*
a.
b.
c.
d.

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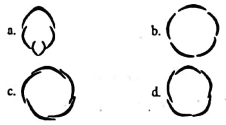
53. Flowers are zygomorphic in: *(2011 Pre)*
a. *Datura* b. Mustard
c. Gulmohur d. Tomato

54. The ovary is half inferior in flowers of: *(2011Pre)*
a. Guava b. Peach
c. Cucumber d. Cotton

55. Aestivation of petals in the flowers of cotton is shown correctly in: *(2010 Mains)*



56. The technical term used for the androecium in a flower of China rose (*Hibiscus rosa sinensis*) is: *(2010 Pre)*
a. Diadelphous b. Polyandrous
c. Polyadelphous d. Monoadelphous

57. In unilocular ovary with a single ovule, the placentation is: *(2010 Pre)*
a. Basal b. Free central
c. Axile d. Marginal

58. An example of axile placentation is: *(2009)*
a. Marigold b. *Dianthus*
c. Lemon d. *Argemone*

59. What type of placentation is seen in sweet pea? *(2006)*
a. Marginal b. Basal
c. Axile d. Free central

60. Bicarpellary gynoecium and oblique ovary occurs in:*(2001)*
a. Mustard b. Banana
c. Pisum d. Brinjal

The Fruit

1. Identify the correct features of Mango and Coconut fruits.
(i) In both fruit is a drupe
(ii) Endocarp is edible in both
iii) Mesocarp in Coconut is fibrous, and in Mango it is fleshy
(iv) In both, fruit develops from monocarpellary ovary
Select the correct option from below: *(2020-Covid)*
a. (i), (ii) and (iii) only b. (i) and (iv) only
c. (i) and (ii) only d. (i), (iii) and (iv) only

62. Coconut fruit is a: *(2017-Delhi)*
a. Drupe b. Berry
c. Nut d. Capsule

63. The morphological nature of the edible part of coconut is: *(2017-Delhi)*
a. Perisperm b. Cotyledon
c. Endosperm d. Pericarp

64. An aggregate fruit is one which develops from: [OS] *(2014)*
a. Multicarpellary superior ovary
b. Multicarpellary syncarpous gynoecium
c. Multicarpellary apocarpous gynoecium
d. Complete inflorescence

65. Placenta and pericarp are both edible portions in: *(2014)*
a. Potato b. Apple
c. Banana d. Tomato

66. A drupe develops in: *(2011 Pre)*
a. Tomato b. Mango
c. Wheat d. Pea

67. Cotyledons and testa are respectively edible in: [OS] *(2009)*
a. Walnut and Tamarind
b. French Bean and Coconut
c. Cashew Nut and Litchi
d. Groundnut and Pomegranate

68. Fleshy receptacle of syconus of Fig encloses a number of: [OS] *(2008)*
a. Berries b. Achenes
c. Mericarps d. Samaras

69. The fruit is chambered, developed from inferior ovary and has seeds with succulent testa is: [OS] *(2008)*
a. Orange b. Cucumber
c. Pomegranate d. Guava

70. Replum occurs in the ovary of: [OS] *(2008)*
a. Mustard b. Pea
c. Sunflower d. Lemon

71. Pineapple (Ananas) fruit develops from: [OS] *(2006)*
a. Cluster of flowers borne compactly on a common axis
b. Multilocular monocarpellary flower
c. Unilocular polycarpellary flower
d. Multipistillate syncarpous flower

72. Edible part of mango is: *(2004)*
a. Receptacle b. Epicarp
c. Mesocarp d. Endocarp

73. Juicy hair-like structures observed in the lemon fruit develop from: [OS] *(2003)*
a. Exocarp b. Mesocarp
c. Endocarp d. Mesocarp and endocarp

74. Edible part in mango is: *(2002)*
a. Mesocarp b. Epicarp
c. Endocarp d. Epidermis

75. Edible part of Banana: [OS] *(2001)*
a. Epicarp
b. Mesocarp and less developed endocarp
c. Endocarp and less developed mesocarp
d. Epicarp & mesocarp

76. Which of the following is a 'true fruit'? *(1996)*
a. Banana b. Fig
c. Apple d. Pear

77. Fruit of *Mangifera indica* is: *(1991)*
a. Berry b. Drupe
c. Capsule d. Siliqua

78. Mango juice is obtained from: *(1989)*
a. Epicarp b. Mesocarp
c. Endocarp d. Pericarp and thalamus

79. Fruit of groundnut is: *(1988)*
a. Legume d. Caryopsis
c. Berry d. Nut

The Seed

80. Which one of the following statements is correct? [MR*] *(2014)*
a. A sterile pistil is called a staminode
b. The seed in grasses is not endospermic
c. Mango is a parthenocarpic fruit
d. A proteinaceous aleurone layer is present in maize grain

81. Seed coat is not thin, membranous in: *(2013)*
a. Gram b. Maize
c. Coconut d. Groundnut

82. Which one of the following statements is correct? *(2011 Pre)*
a. Flower of tulip is a modified shoot
b. In tomato, fruit is a capsule
c. Seeds of orchids have oil-rich endosperms
d. Placentation in *Primrose* is basal

83. Scutellum of Maize is: *(2010 Pre)*
a. Cotyledon b. Endosperm
c. Tegmen d. Testa

84. An example of a seed with endosperm, perisperm and caruncle is: [OS] *(2009)*
a. Castor b. Coffee
c. Lily d. Cotton

85. Endosperm is consumed by the developing embryo in: *(2008)*
a. Monocots b. Dicots
c. Ferns d. All of the above

86. In cereal grain, single cotyledon is represented by: *(2006)*
a. Coleoptile b. Coleorhiza
c. Scutellum d. Prophyll

87. What would be number of chromosomes in the cells of aleurone layer in plant species have 8 chromosomes in its synergids? *(2006)*
a. 8 b. 16
c. 24 d. 32

88. The aleurone layer in maize grain is specially rich in: *(2003)*
a. Proteins b. Starch
c. Lipids d. Auxins

89. Embryo of sunflower have: *(1998)*
a. Two cotyledons b. One cotyledons
c. Eight cotyledons d. Cotyledons absent

90. In groundnut, the food/oil reserve is present in: *(1990)*
a. Epicarp b. Mesocarp
c. Endosperm d. Cotyledons

91. Tegmen develops from: *(1990)*
a. Funiculus b. Chalaza
c. Inner integument d. Outer integument

92. Oil reserve of groundnut is present in: *(1990)*
a. Embryo b. Cotyledons
c. Endosperm d. Underground tubers

Description of Familes-Fabaceae, Solanaceae, Liliaceae

93. Family Fabaceae differs from Solanaceae and Liliaceae. With respect to the stamens, pick out the characteristics specific to family Fabaceae but not found in Solanaceae or Liliaceae. [MR*] *(2023)*
a. Epiphyllous and Dithecous anthers
b. Diadelphous and Dithecous anthers
c. Polyadelphous and epipetalous stamens
d. Monoadelphous and Monothecous anthers

94. The Floral Diagram represents which one of the following families *(2022 Re)*

a. Liliaceae b. Fabaceae
c. Brassicaceae d. Solanaceae

95. Match Column - I with Column - II [MR*] *(2021)*

	Column-I		Column-II
A.	$\oplus \varphi \nearrow K_{(3)}C_{(3+2+0)}$ $A_{(6=1+5)}\underline{G_{(3)}}$	(i)	Brassicaceae
B.	$\oplus \varphi \nearrow K_{(3)}\widehat{C_{(3)}}A_3G_2$	(ii)	Liliaceae
C.	$\oplus \varphi \nearrow P_{(3+3)}\widehat{A_{3+3}}G_{(3)}$	(iii)	Fabaceae
D.	$\oplus \varphi \nearrow K_{2+2}C_4A_{2+4}\underline{G_{(2)}}$	(iv)	Solanaceae

Select the correct answer from the options given below.
a. A-i B-ii C-iii D-iv
b. A-ii B-iii C-iv D-i
c. A-iv B-ii C-i D-iii
d. A-iii B-iv C-ii D-i

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96. Which of the following is the correct floral formula of Liliaceae? *(2020-Covid)*

a. $\oplus \delta \varphi K_{(3)} \widehat{C_{(3)}} A_3 G_{(3)}$ b. $Br \oplus \delta \varphi \widehat{P_{(3+3)}} \widehat{A_{3+3}} G_{(3)}$

c. $\oplus \delta \varphi K_{(3)} \widehat{C_{(3)}} A_3 G_{(3)}$ d. $\% \delta \varphi C_{1+2+(2)} A_{9+1} G_{(1)}$

97. Tricarpellary, syncarpous gynoecium is found in flowers of: *(2016 - I)*

a. Liliaceae b. Solanaceae

c. Fabaceae d. Poaceae

98. Keel is the characteristic feature of flower of: *(2015)*

a. Aloe b. Tomato

c. Tulip d. *Indigofera*

99. Vexillary aestivation is characteristic of the family: *(2012 Pre)*

a. Brassicaceae b. Fabaceae

c. Asteraceae d. Solanaceae

100. How many plants in the list given below have composite fruits that develop from an inflorescence?

Walnut, poppy, radish, fig, pineapple, apple, tomato, mulberry. *(2012 Pre)*

a. Three b. Four

c. Five d. Two

101. The correct floral formula of chili is: *(2011 Pre)*

a. $\oplus \delta \varphi K_5 \widehat{C_5} \widehat{A_{(5)}} G_{(2)}$ b. $\oplus \delta \varphi K_{(5)} C_5 A_5 G_{(2)}$

c. $\oplus \delta \varphi K_{(5)} \widehat{C_{(5)}} A_5 G_{(2)}$ d. $\oplus \delta \varphi K_{(5)} C_{(5)} A_{(5)} G_4$

102. Consider the following four statements A, B, C and D and select the right option of two correct statements. *(2010 Mains)*

A. In Vexillary aestivation, the large posterior petal is called standard, two lateral wings and two small anterior keel.

B. Floral formula of Liliaceae is $\oplus \delta \varphi P_{3+3} A_{3+3} G_{(3)}$

C. In Pea flower the stamens are Monoadelphous

D. Floral formula of Solanaceae is $\oplus \delta \varphi K_{(5)} C_{(5)} A_{(5)} G_{(2)}$

Correct statements are

a. A and C b. A and B

c. B and C d. C and D

103. Keel is characteristic of the flower of: *(2010 Pre)*

a. *Cassia* b. *Calotropis*

c. Bean d. Gulmohur

104. Floral formula $\oplus \delta \varphi K_{(5)} \widehat{C_{(5)}} A_5 G_{(2)}$ is that of: *(2009)*

a. Soyabean b. Tobacco

c. Tulip d. Sun Hemp

105. Pentamerous actinomorphic flowers, bicarpellary ovary with oblique septum and a fruit of capsule or berry, belong to family: *(2006)*

a. Liliaceae b. Asteraceae

c. Brassicaceae d. Solanaceae

106. Which of the following plants produces seeds but not flowers? **[OS]** *(2002)*

a. Maize b. Mint

c. Peepal d. Pinus

107. Tetradynamous conditions occur in: *(2001)*

a. Cruciferae b. Malvaceae

c. Solanaceae d. Liliaceae

108. Which is expressing right appropriate pairing? *(2000)*

a. Brassicaceae - Sunflower

b. Malvaceae - Cotton

c. Papilionaceae - Catechu

d. Liliaceae - Wheat

109. Pulses are obtained from: *(1993)*

a. Fabaceae b. Asteraceae

c. Poaceae d. Solanaceae

110. Epipetalous stamens with free filaments and fused anthers occur in: *(1992)*

a. Asteraceae b. Solanaceae

c. Liliaceae d. Poaceae

111. Floral formula of tomato/tobacco is: *(1992, 89)*

a. $\oplus \delta \varphi K_{\infty} A_{\infty} \underline{G_{(2)}}$ b. $\oplus \delta \varphi K_{2+2} C_4 A_{2+4} \underline{G_2}$

c. $\oplus \delta \varphi P_2 A_2 \underline{G_2}$ d. $\oplus \delta \varphi K_{(5)} \widehat{C_{(5)}} A_5 G_{(2)}$

112. Botanical name of cauliflower is: *(1991)*

a. *Brassica oleracea var. capitata*

b. *Brassica campestris*

c. *Brassica oleracea var. botrytis*

d. *Brassica oleracea var. gemmifera*

113. $\oplus \delta \varphi K_{(5)} \widehat{C_5} \widehat{A_5} G_{(2)}$ is floral formula of: *(1991)*

a. Liliaceae b. Solanaceae

c. Asteraceae d. Fabaceae

114. Epipetalous and syngenesious stamens occur in: **[OS]** *(1991)*

a. Solanaceae b. Brassicaceae

c. Fabaceae d. Asteraceae

115. A family delimited by type of inflorescence is: *(1991)*

a. Fabaceae b. Asteraceae

c. Solanaceae d. Fabaceae

116. Syngenesious condition is found in: **[OS]** *(1991)*

a. Asteraceae b. Labiatae

c. Solanaceae d. Fabaceae

Answer Key

1. (d)	2. (a)	3. (b)	4. (a)	5. (a)	6. (d)	7. (a)	8. (c)	9. (d)	10. (d)
11. (c)	12. (c)	13. (a)	14. (a)	15. (d)	16. (c)	17. (d)	18. (b)	19. (c)	20. (c)
21. (c)	22. (b)	23. (b)	24. (a)	25. (b)	26. (a)	27. (a)	28. (d)	29. (d)	30. (c)
31. (c)	32. (c)	33. (b)	34. (d)	35. (c)	36. (d)	37. (c)	38. (c)	39. (c)	40. (d)
41. (d)	42. (c)	43. (b)	44. (a)	45. (a)	46. (a)	47. (c)	48. (d)	49. (b)	50. (c)
51. (a)	52. (d)	53. (c)	54. (b)	55. (d)	56. (d)	57. (a)	58. (c)	59. (a)	60. (d)
61. (d)	62. (a)	63. (c)	64. (c)	65. (d)	66. (b)	67. (d)	68. (b)	69. (c)	70. (a)
71. (a)	72. (c)	73. (c)	74. (a)	75. (c)	76. (a)	77. (b)	78. (b)	79. (a)	80. (d)
81. (c)	82. (a)	83. (a)	84. (a)	85. (b)	86. (c)	87. (c)	88. (a)	89. (a)	90. (d)
91. (c)	92. (b)	93. (b)	94. (c)	95. (d)	96. (b)	97. (a)	98. (d)	99. (b)	100. (a)
101. (c)	102. (b)	103. (c)	104. (b)	105. (d)	106. (d)	107. (a)	108. (b)	109. (a)	110. (a)
111. (d)	112. (c)	113. (b)	114. (d)	115. (b)	116. (a)				

Explanations

1. (d) In some monocots, the primary root is short lived and replaced by a large number of roots. These roots originate from the base of the stem and constitute the fibrous root system.

2. (a) Halophytes grow in water with high salinity such as swampy areas and marshes. Roots in such plant comes out of the ground and grew vertically upwards. Such roots are called pneumatophores, that help to get oxygen for respiration.

3. (b) Adventitious roots of sweet potato, get swollen and store food.

4. (a) Root hairs are very fine, delicate, thread-like structures formed from epidermal cells in region behind region of elongation, i.e., maturation region. They absorb water and minerals from the soil.

5. (a) Floating roots in *Pistia* are white spongy and arise from node stem and store air. They help plants to remain on the water surface.

6. (d) Root is covered at apex by root cap. A few millimetres above the root cap is region of meristematic activity where cell division takes place, the cell proximal to this region undergo rapid elongation and enlargement and the zone proximal to region of elongation is called region of maturation.

7. (a) In some plants such as *Rhizophora* that grows in swampy areas, many roots come out of the ground and grow vertically upwards to get oxygen for respiration. Such roots are called pneumatophores.

8. (c) *Rafflesia arnoldii* is the world largest flower, and it is a total root parasite. It is a parasitic plant, with no visible leaves, roots or stem.

9. (d) Velamen is found in aerial roots of orchids. In many epiphytic orchids, the aerial roots are covered by a hygroscopic velamen tissue. They absorb water from the atmosphere.

10. (d) Rhizomes are generally underground stem structures that have distinct nodes and internodes from which roots and shoots can emerge. Rhizomes are adapted for storage and vegetative reproduction.

11. (c) Axillary buds of stems may also get modified into woody, straight and pointed thorns for the protection of plant. They are found in many plants such as *Bougainvillea*.

12. (c) In Phylloclade stems are modified into flat green organs performing the functions of leaves. i.e., photosynthesis.

Examples: *Opuntia* (Flattened stem) and *Euphorbia* (Cylindrical stem)

13. (a) Leaves of certain insectivorous plants such as pitcher plant (*Nepenthes*) and Venus-fly trap are modified leaves.

14. (a) Edible underground stem becomes fleshy and tuberous due to storage of food in it. E.g., Potato, Ginger, Turmeric, Zaminkand, and *Colocasia*.

15. (d) Only statement A is incorrect.

Axillary buds of stems get modified into woody, straight and pointed thorns in *Citrus* and *Bougainvillea*.

16. (c) In *Opuntia*, leaves become modified into spines to reduce transpiration under xerophytic adaptations.

17. (d) Phyllode is present in Australian Acacia.

18. (b) Whorled simple leaves with reticulate venation are present in *Alstonia*. In this, more than two leaves arise at a node and form a whorl.

19. (c) Lamina of leaves of venus fly trap, are modified jaws. Jaws bear sensitive bristles that are sensitive to touch stimuli. When an insect touches these hairs, causes rapid turgor pressure changes which closes the leaf.

20. (c) The scientific name of bladderwort, sundew, venus-fly trap are *Utricularia*, *Drosera*, and *Dionea* respectively.

21. (c) *Aldrovanda* and *Utricularia* are insectivorous plants.

22. (b) A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem. Internodes do not elongate and the axis gets condensed. The apex produces different kinds of floral appendages laterally at successive nodes instead of leaves.

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93. **(b)** In Fabaceae family the filaments of nine stamen are united into one bundle and tenth posterior stamen stand apart (diadelphous condition). Anther in fabaceae is of two lobes or two theca thus called dithecous anther. These two characteristics are present in the members of Fabaceae family but not found in members of Solanacea or Liliaceae family.

Androecium: ten, diadelphous, anther dithecous

94. **(c)** Brassicaceae

The given floral diagram represents the Brassicaceae family having floral formula $\oplus \varphi \overset{\frown}{\sigma} K_{2+2}C_4A_{2+4}\underline{G}_{(2)}$.

95. **(d)** The floral formula of given families is as follows:

Brassicaceae - $\oplus \varphi \overset{\frown}{\sigma} K_{2+2}C_4A_{2+4}\underline{G}_{(2)}$

Liliaceae - $Br \oplus \varphi \overset{\frown}{\sigma} \widehat{P_{(3+3)}A_{3+3}}\underline{G}_{(3)}$

Fabaceae - $\% \varphi \overset{\frown}{\sigma} K_{(5)}C_{1+2+(2)}A_{(9)+1}\underline{G}_1$

Solanaceae - $\oplus \varphi \overset{\frown}{\sigma} K_{(5)}\widehat{C_{(5)}A_5}\underline{G}_2$

96. **(b)** Liliaceae commonly called the 'Lily family' is a characteristic representative of monocotyledonous plants. Its floral formula is $Br \oplus \varphi \overset{\frown}{\sigma} \widehat{P_{(3+3)}A_{3+3}}\underline{G}_{(3)}$

97. **(a)** Gynoecium is tricarpellary, syncarpous, superior ovary, trilocular with many ovules, axile placentation present in family Liliaceae.

98. **(d)** Keel is the characteristics of Fabaceae family that was earlier called Papilonaceae. E.g., gram, arhar, moong, sem, groundnut, soyabean, *Indigofera*, sun hemp, *Sesbania*, *Trifolium*, *Lupin*, sweet pea and Muliathi.

99. **(b)** Vexillary aestivation is characteristic of the family Fabaceae.

100. **(a)** Three plants namely pineapple, mulberry and fig, develop from a cluster of flowers rather than a single flower.

101. **(c)** The given floral formula $\oplus \varphi \overset{\frown}{\sigma} K_{(5)}\widehat{C_{(5)}A_{(9)}}\underline{G}_{(2)}$ belongs to family Solanaceae.

102. **(b)** In pea flower, the stamens are diadelphous. Floral formula of Solanaceae $\oplus \varphi \overset{\frown}{\sigma} K_{(5)}C_{(5)}A_{(5)}\underline{G}_{(2)}$

103. **(c)** Keel is the characteristics of Fabaceae family. E.g., Be

104. **(b)** Tobacco belong to the Solanaceae family, has flora formula; $\oplus \varphi \overset{\frown}{\sigma} K_{(5)}\widehat{C_{(5)}A_{(5)}}\underline{G}_{(2)}$

105. **(d)** Floral formula of Solanaceae $\oplus \varphi \overset{\frown}{\sigma} K_{(5)}\widehat{C_{(5)}A_{(5)}}\underline{G}_{(2)}$

106. **(d)** *Pinus* is a gymnosperm that produces naked seeds.

107. **(a)** The family Cruciferae (Brassicaceae) is commonly known as mustard family. In this family, androecium is and tetradynamous (having four long and two short stamens)

108. **(b)** Members of Malvaceae family include okra, cotton, and cacao.

109. **(a)** Fabaceae is a sub family of family Leguminosae. Many plants belonging to this family are sources of pulses.

110. **(a)** Epipetalous stamens with free filaments and fused anthers occur in Asteraceae.

111. **(d)** Tomato/tobacco belong to the family Solanaceae. Floral formula for this family is $\oplus \varphi \overset{\frown}{\sigma} K_{(5)}\widehat{C_{(5)}A_5}\underline{G}_{(2)}$

112. **(c)** Cauliflower → *Brassica oleracea* var. *botrytis*

Cabbage → *Brassica oleracea* var. *capitata*

Turnip → *Brassica campestris*

113. **(b)** The floral formula of family Solanaceae is $\oplus \varphi \overset{\frown}{\sigma} K_{(5)}\widehat{C_{(5)}A_5}\underline{G}_{(2)}$

114. **(d)** Syngenesious condition is found in Asteraceae. It is the condition when stamens are united by their anthers (filaments free). Epipetalous condition is also seen here.

115. **(b)** Asteraceae is a very large widespread family of dail plants. They are generally easy to distinguish from othe plants, mainly because of their characteristic inflorescence.

116. **(a)** Syngenesious condition of stamens is found whe filaments are free and the anthers are united together into tube, e.g., Sunflower (Asteraceae).

CHAPTER 6

Anatomy of Flowering Plants

Meristematic Tissues

1. Consider the following plant tissues: *(2023-Manipur)*

A. Axillary buds
B. Fascicular vascular cambium
C. Interfascicular cambium
D. Cork cambium
E. Intercalary meristem

Identify the lateral meristems among the above.

a. (A), (C) and (D) only
b. (B), (C) and (D) only
c. (A), (B), (C) and (E) only
d. (A), (B), (D) and (E) only

2. Which one of the following is not a lateral meristem? *(2010)*

a. Interfascicular cambium b. Phellogen
c. Intercalary meristem d. Intrafascicular cambium

3. The apical meristem of the root is present: *(2003)*

a. Only in radicals
b. Only in tap roots
c. Only in adventitious roots
d. In all the roots

4. Axillary bud and terminal bud derived from the activity of: *(2002)*

a. Lateral meristem b. Intercalary meristem
c. Apical meristem d. Parenchyma

5. Growth of leaf primordia: [OS] *(1998)*

a. First apical then marginal
b. Only apical
c. Only marginal
d. Lateral

6. Which of the following plant cells will show totipotency? [OS] *(1993)*

a. Sieve tubes b. Xylem vessels
c. Meristem d. Cork cells

7. Collenchyma occurs in the stem and petioles of: *(1990)*

a. Xerophytes b. Monocots
c. Dicot herbs d. Hydrophytes

8. Which meristem helps in increasing girth? *(1988)*

a. Lateral meristem b. Intercalary meristem
c. Primary meristem d. Apical meristem

9. Tunica corpus theory is connected with: [OS] *(1988)*

a. Root apex b. Root cap
c. Shoot apex d. Secondary growth

Permanent Tissues

10. Given below are two statements: *(2023)*

Statement I: Endarch and exarch are the terms often used for describing the position of secondary xylem in the plant body.

Statement II: Exarch condition is the most common feature of the root system.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is incorrect but Statement II is true.
b. Both Statement I and Statement II are true.
c. Both Statement I and Statement II are false.
d. Statement I is correct but Statement II is false.

11. The type of tissue commonly found in the fruit wall of nuts is *(2022 Re)*

a. Sclereid b. Parenchyma
c. Collenchyma d. Sclerenchyma

12. Read the following statements about the vascular bundles: [MR*] *(2022)*

A. In roots, xylem and phloem in a vascular bundle are arranged in an alternate manner along the different radii
B. Conjoint closed vascular bundles do not possess cambium
C. In open vascular bundles, cambium is present in between xylem and phloem
D. The vascular bundles of dicotyledonous stem possess endarch protoxylem
E. In monocotyledonous root, usually there are more than six xylem bundles present

Choose the correct answer from the options given below.

a. A, C, D and E only b. A, B and D only
c. B, C, D and E only d. A, B, C and D only

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13. In old trees the greater part of secondary xylem is dark brown and resistant to insect attack due to *(2022)*

A. Secretion of secondary metabolites and their deposition in the lumen of vessels

B. Deposition of organic compounds like tannins and resins in the central layers of stem

C. Deposition of suberin and aromatic substances in the outer layer of stem

D. Deposition of tannins, gum, resin and aromatic substances in the peripheral layers of stem

E. Presence of parenchyma cells, functionally active xylem elements and essential oils.

Choose the correct answer from the options given below.

a. B and D only b. A and B only
c. C and D only d. D and E only

14. Match List-1 with List-2 [MR^A] *(2021)*

	List-1		List-2
A.	Cells with active cell division capacity	(i)	Vascular tissues
B.	Tissue having all cells similar in structure and function	(ii)	Meristematic tissue
C.	Tissue having different types of cells	(iii)	Sclereids
D.	Dead cells with highly thickened walls and narrow lumen	(iv)	Simple Tissue

Select the correct answer from the options given below.

a. A-iv B-iii C-ii D-i
b. A-i B-ii C-iii D-iv
c. A-iii B-ii C-iv D-i
d. A-ii B-iv C-i D-iii

15. The transverse section of a plant shows following anatomical features: [MR^A] *(2020)*

1. Large number of scattered vascular bundles surrounded by bundle sheath.
2. Large conspicuous parenchymatous ground tissue.
3. Vascular bundles conjoint and closed.
4. Phloem parenchyma absent.

Identify the category of plant and its part:

a. Monocotyledonous root
b. Dicotyledonous stem
c. Dicotyledonous root
d. Monocotyledonous stem

16. Phloem in gymnosperms lacks *(2019)*

a. Albuminous cells and sieve cells
b. Sieve tubes only
c. Companion cells only
d. Both sieve tubes and companion cells

17. Which of the following is made up of dead cells? *(2017)*

a. Xylem parenchyma b. Collenchyma
c. Phellem d. Phloem

18. The balloon-shaped structures called tyloses: [OS] *(20*

a. Are extensions of xylem parenchyma cells into ves
b. Are linked to the ascent of sap through xylem vess
c. Originate in the lumen of vessels
d. Characterise the sapwood

19. Tracheids differ from other tracheary elements in: [OS] *(2*

a. Being lignified b. Having casparian strip
c. Being imperforate d. Lacking nucleus

20. Companion cells are closely associated with: *(201*

a. Guard cells b. Sieve elements
c. Vessel elements d. Trichomes

21. Gymnosperms are also called soft wood spermatop because they lack: *(201*

a. Xylem fibers b. Cambium
c. Phloem fibers d. Thick-walled tracheids

22. Function of companion cells is: *(2011 Ma*

a. Loading of sucrose into sieve elements by pa transport
b. Loading of sucrose into sieve elements
c. Providing energy to sieve elements for active transp
d. Providing water to phloem

23. The chief water conducting elements of xylem gymnosperms are: *(*

a. Fibers b. Transfusion tissue
c. Tracheids d. Vessels

24. Transport of food material in higher plants takes p through: *(*

a. Companion cells b. Sieve elements
c. Tracheids d. Transfusion tissue

25. Annular and spirally thickened conducting elements gener develop in protoxylem when root or stem is: [OS] *(2*

a. Widening b. Differentiating
c. Maturing d. Elongating

26. Common feature in vessel elements and sieve tube elem is: *(2*

a. Enucleate condition b. Presence of P-protein
c. Thick secondary wall d. Pores on lateral walls

27. Chlorenchyma found in: *(20*

a. Cytoplasm of Chlorella
b. Mycelium of a green mould such as Aspergillus
c. Spore capsule of a moss
d. Pollen tube of Pinus

28. Which of the following statement is true? *(20*

a. Vessels are multicellular and with wide lumen
b. Tracheids are multicellular and with narrow lumen.
c. Vessels are unicellular and with narrow lumen.
d. Tracheids are unicellular and with wide lumen.

29. Vessels are found in: *(2002)*

a. All angiosperms and some gymnosperm
b. Most of the angiosperms and few gymnosperms
c. All angiosperms, all gymnosperms and some pteridophyta
d. All pteridophyta

30. Transition of exarch bundles of root to endarch bundles of stem occurs in: *(1999)*

a. Epicotyl b. Hypocotyl
c. Apical bud d. Coleoptile

31. At maturity, which of the following is non-nucleated? *(1997)*

a. Palisade call b. Cortical cell
c. Sieve cell d. Companion cell

32. Which of the following is not true about 'sclereids'? *(1996)*

a. These are groups of living cells
b. These are found in nut shells, guava pulp, pear
c. These are also called stone cells
d. These are form of sclerenchyma with fibres

33. Bordered pits are found in: [OS] *(1993)*

a. Sieve cells b. Vessel wall
c. Companion cells d. Sieve tube wall

34. An organised and differentiated cellular structure having cytoplasm but no nucleus is: *(1991)*

a. Vessels b. Xylem parenchyma
c. Sieve tubes d. Tracheids

35. Angular collenchyma occurs in: [OS] *(1991)*

a. *Cucurbita* b. *Helianthus*
c. *Althaea* d. *Salvia*

36. Collenchyma occurs in: *(1990)*

a. Herbaceous climbers b. Woody climbers
c. Climbing stems d. Water plants

37. Sieve tubes are suited for translocation of food because they possess: *(1989)*

a. Bordered pits
b. No ends walls
c. Broader lumen and perforated cross walls
d. No protoplasm

38. Death of protoplasm is a pre-requisite for a vital function like: *(1989)*

a. Transport of sap b. Transport of food
c. Absorption of water d. Gaseous exchange

Tissue System

39. Stomata in grass leaf are: [OS] *(2018)*

a. Dumb-bell shaped b. Kidney shaped
c. Rectangular. d. Barrel shaped

40. Cortex is the region found between: *(2016 - II)*

a. Endodermis and pith
b. Endodermis and vascular bundle
c. Epidermis and stele
d. Pericycle and endodermis

41. Specialised epidermal cells surrounding the guard cells are called *(2016 - I)*

a. Complementary cells b. Subsidiary cells
c. Bulliform cells d. Lenticels

42. Vascular bundles in monocotyledons are considered closed because: *(2015)*

a. There are no vessels with perforations
b. Xylem is surrounded all around by phloem
c. A bundle sheath surrounds each bundle
d. Cambium is absent

43. Closed vascular bundles lack: *(2012 Pre)*

a. Pith b. Ground tissue
c. Conjunctive tissue d. Cambium

44. Water containing cavities in vascular bundles are found in: [OS] *(2012 Pre)*

a. Pinus b. Sunflower
c. Maize d. Cycas

45. Some vascular bundles are described as open because these: *(2011 Mains)*

a. Possess conjunctive tissue between xylem and phloem
b. Are not surrounded by pericycle
c. Are surrounded by pericycle but no endodermis
d. Are capable of producing secondary xylem and phloem

46. Ground tissue includes: *(2011 Pre)*

a. All tissues internal to endodermis
b. All tissues external to endodermis
c. All tissues except epidermis and vascular bundles
d. Epidermis and cortex

47. In Barley stem, vascular bundles are: [OS] *(2009)*

a. Open and scattered b. Closed and scattered
c. Closed and radial d. Open and in a ring

48. Vascular tissues of flowering plant develop from: *(2008)*

a. Dermatogen b. Periblem
c. Plerome d. Phellogen

49. A bicollateral vascular bundle is characterised by: [OS] *(1992)*

a. Phloem being sandwiched between xylem
b. Transverse splitting of vascular bundle
c. Longitudinal splitting of vascular bundle
d. Xylem being sandwiched between phloem

50. Vascular cambium produces: *(1992, 1990)*

a. Primary xylem and primary phloem
b. Secondary xylem and secondary phloem
c. Primary xylem and secondary phloem
d. Secondary xylem and primary phloem

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Anatomy of Dicot & Monocot Plants

51. The transverse section of a plant part showed polyarch, radial and exarch xylem, with endodermis and pericycle. The plant part is identified as: [MR*] *(2023-Manipur)*

a. Monocot root b. Dicot root
c. Dicot stem d. Monocot stem

52. Initiation of lateral roots and vascular cambium during secondary growth takes place in cells of *(2022 Re)*

a. Pericycle b. Epiblema
c. Cortex d. Endodermis

53. Select the correct pair. [MR*] *(2021)*

a.	In dicot leaves, vascular bundles are surrounded by large thick-walled cells	-	Conjunctive tissue
b.	Cells of medullary rays that form part of cambial rings	-	Interfascicular cambium
c.	Loose parenchyma cells rupturing the epidermis and forming a lens-shaped opening in bark	-	Spongy parenchyma
d.	Large colorless empty cells in the epidermis of grass leaves	-	Subsidiary cells

54. Large, empty colourless cells of the adaxial epidermis along the veins of grass leaves are *(2020-Covid)*

a. Guard cells b. Bundle sheath cells
c. Bulliform cells d. Lenticels

55. Grass leaves curl inwards during very dry weather. Select the most appropriate reason from the following *(2019)*

a. Closure of stomata
b. Flaccidity of bulliform cells
c. Shrinkage of air spaces in spongy mesophyll
d. Tyloses in vessels

56. Secondary xylem and phloem in dicot stem are produced by *(2018)*

a. Apical meristem b. Vascular cambium
c. Phellogen d. Axillary meristems

57. Casparian strips occur in *(2018)*

a. Epidermis b. Pericycle
c. Cortex d. Endodermis

58. A major characteristic of the monocot root is the presence of: *(2015)*

a. Vasculature without cambium
b. Cambium sandwiched between phloem and xylem along the radius
c. Open vascular bundles
d. Scattered vascular bundles

59. As compared to a dicot root, a monocot root has: *(2012 M)*

a. More abundant secondary xylem
b. Many xylem bundles
c. Inconspicuous annual rings
d. Relatively thicker periderm

60. Anatomically fairly old dicotyledonous root is distinguished from dicotyledonous stem by: [MR*] *(2)*

a. Position of protoxylem
b. Absence of secondary xylem
c. Absence of secondary phloem
d. Presence of cortex

61. Palisade parenchyma is absent in leaves of: *(2)*

a. Gram b. Soyabean
c. *Sorghum* d. Mustard

62. Passage cells are thin walled cells found in: *(2)*

a. Phloem elements to serve as entry points
b. Testa of seeds for emergence of embryonal axis
c. Central area of style for passage of pollen tube
d. Endodermis of roots to facilitate rapid transport of from cortex to pericycle

63. Four radial vascular bundles are found in: *(2)*

a. Dicot root b. Monocot root
c. Dicot stem d. Monocot stem

64. Casparian bands are found in: *(1)*

a. Endodermis b. Pericycle
c. Periderm d. Cortex

65. A plant bears fruit, has a column of vascular tissue and root system. This plant is a: *(1)*

a. Angiosperm and dicot
b. Gymnosperm and dicot
c. Angiosperm and monocot
d. Gymnosperm and monocot

66. Casparian strip occurs in a: *(1)*

a. Endodermis b. Exodermis
c. Pericycle d. Epidermis

67. Where do the casparian bands occur? *(1994,*

a. Epidermis b. Endodermis
c. Pericycle d. Phloem

68. What is true about a monocot leaf? *(1992, 19*

a. Reticulate venation
b. Absence of bulliform cells from epidermis
c. Mesophyll not differentiated into palisade and spo tissues
d. Well differentiated mesophyll

69. Pericycle of roots produces: *(19*

a. Mechanical support b. Lateral roots
c. Vascular bundles d. Adventitious buds

70. Monocot leaves possess: *(1990)*

a. Intercalary meristem
b. Lateral meristem
c. Apical meristem
d. Mass meristem

71. Pith and cortex do not differentiate in: *(1988)*

a. Monocot stem b. Dicot stem
c. Monocot root d. Dicot root

Secondary Growth

72. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R: *(2023)*

Assertion A: Late wood has fewer xylary elements with narrow vessels.

Reason R: Cambium is less active in winters.

In the light of the above statements, choose the correct answer from the options given below:

a. A is false but R is true.
b. Both A and R are true and R is the correct explanation of A.
c. Both A and R are true but R is NOT the correct explanation of A.
d. A is true but R is false.

73. Identify the correct statements: [MR*] *(2023)*

A. Lenticels are the lens-shaped openings permitting the exchange of gases.
B. Bark formed early in the season is called hard bark.
C. Bark is a technical term that refers to all tissues exterior to vascular cambium.
D. Bark refers to periderm and secondary phloem.
E. Phellogen is single-layered in thickness. Choose the correct answer from the options given below:

a. B and C only b. B, C and E only
c. A and D only d. A, B and D only

74. Consider the following tissues in the stellar region of a stem showing secondary growth. [MR*] *(2023-Manipur)*

(A) Primary xylem (B) Secondary xylem
(C) Primary phloem (D) Secondary phloem

Arrange these in the **correct** sequence of their position from pith towards cortex.

a. (A), (B), (D), (C) b. (B), (A), (C), (D)
c. (A), (B), (C), (D) d. (B), (A), (D), (C)

75. Interfascicular cambium is present between *(2022 Re)*

a. Secondary xylem and secondary phloem
b. Primary xylem and primary phloem
c. Pericycle and endodermis Two vascular bundles
d. Two vascular bundles

76. The anatomy of springwood shows some peculiar features. Identify the correct set of statements about springwood.

A. It is also called as the earlywood
B. In spring season cambium produces xylem elements with narrow vessels
C. It is lighter in colour.
D. The springwood along with autumnwood shows alternate concentric rings forming annual rings
E. It has lower density

Choose the correct answer from the options given below.

a. C, D and E only b. A, B, D and E only
c. A, C, D and E only d. A, B and D only

77. Match List -1 with List - 2 *(2021)*

	List- 1		List - 2
A.	Lenticels	(i)	Phellogen
B.	Cork cambium	(ii)	Suberin deposition
C.	Secondary cortex	(iii)	Exchange of gases
D.	Cork	(iv)	Phelloderm

Choose the correct answer from the options given below:

a. A-iii B-i C-iv D-ii
b. A-ii B-iii C-iv D-i
c. A-iv B-ii C-i D-iii
d. A-iv B-i C-iii D-ii

78. Identify the **incorrect** statement. *(2020)*

a. Sapwood is involved in conduction of water and minerals from root to leaf.
b. Sapwood is the innermost secondary xylem and is lighter in colour.
c. Due to deposition of tannins, resins, oils, etc., heart wood is dark in colour.
d. Heart wood does not conduct water but gives mechanical support.

79. Which of the following statements about cork cambium is **incorrect**? *(2020-Covid)*

a. It forms a part of periderm
b. It is responsible for the formation of lenticels
c. It is a couple of layers thick
d. It forms secondary cortex on its outerside

80. Which of the statements given below is **not** true about formation of annual rings in trees? *(2019)*

a. Annual ring is a combination of spring wood and autumn wood produced in a year
b. Differential activity of cambium causes light and dark bands of tissue-early and late wood respectively.
c. Activity of cambium depends upon variation in climate.
d. Annual rings are not prominent in trees of temperate region.

81. Plants having little or no secondary growth are *(2018)*

a. Grasses b. Deciduous angiosperms
c. Conifers d. Cycads

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82. The vascular cambium normally gives rise to: *(2017-Delhi)*
a. Phelloderm b. Primary phloem
c. Secondary xylem d. Periderm

83. Identify the wrong statement in context of heartwood: *(2017-Delhi)*
a. Organic compounds are deposited in it
b. It is highly durable
c. It conducts water and minerals efficiently
d. It comprises dead elements with highly lignified wall

84. Read the different components from (A) to (D) in the list given below and tell the correct order of the components with reference to their arrangement from outer side to inner side in a woody dicot stem: *(2015 Re)*
A. Secondary cortex B. Wood
C. Secondary phloem D. Phellem
The correct order is:
a. (A), (B), (D), (C) b. (D), (A), (C), (B)
c. (D), (C), (A), (B) d. (C), (D), (B), (A)

85. You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will you use to distinguish between the two? *(2014)*
a. Cortical cells b. Secondary xylem
c. Secondary phloem d. Protoxylem

86. Lenticels are involved in: *(2013)*
a. Photosynthesis b. Transpiration
c. Gaseous exchange d. Food transport

87. Interfascicular cambium develops from the cells of: *(2013)*
a. Pericycle b. Medullary rays
c. Xylem parenchyma d. Endodermis

88. Age of a tree can be estimated by: *(2013)*
a. Diameter of its heartwood
b. Its height and girth
c. Biomass
d. Number of annual rings

89. The common bottle cork is a product of: *(2012 Pre)*
a. Vascular Cambium b. Dermatogen
c. Phellogen d. Xylem

90. The cork cambium, cork and secondary cortex are collectively called: *(2011 Pre)*
a. Phellem b. Phelloderm
c. Phellogen d. Periderm

91. Heart wood differs from sapwood in: *(2010)*
a. Absence of vessels and parenchyma
b. Having dead and non-conducting elements
c. Being susceptible to pests and pathogens
d. Presence of rays and fibres

92. Secondary growth is best observed in: *(2007)*
a. Teak and Pine
b. Deodar and Fern
c. Wheat and Maiden Hair Fern
d. Sugarcane and sunflower

93. Main function of lenticel is: *(2000)*
a. Transpiration b. Guttation
c. Gaseous exchange d. Bleeding

94. Diffuse porous wood is characteristics of those plants which are growing in: [OS] *(2000)*
a. Alpine region b. Cold winter regions
c. Temperate climate d. Tropics

95. What happens in plants during vascularisation? [OS] *(2000)*
a. Differentiation of procambium, formation of primary phloem followed by formation of primary xylem
b. Differentiation of procambium followed by the formation of primary phloem and xylem simultaneously
c. Formation of procambium, primary phloem and xylem simultaneously
d. Differentiation of procambium followed by the formation of secondary xylem.

96. Extrastelar secondary growth takes place by: [OS] *(1998)*
a. Vascular cambium b. Phellogen
c. Phellem d. Phelloderm

97. As a tree grow older, which of the following increases most rapidly in thickness? *(1994)*
a. Heart wood b. Sap wood
c. Phloem d. Cortex

98. Periderm is produced by: *(1993)*
a. Vascular cambium b. Fascicular cambium
c. Phellogen d. Intrafascicular cambium

99. A narrow layer of thin walled cells found between phloem bark and wood of a dicot is: *(1993)*
a. Cork cambium b. Vascular cambium
c. Endodermis d. Pericycle

100. Which exposed wood will decay faster? *(1993)*
a. Sapwood d. Wood with lot of fibres
c. Softwood d. Heartwood

101. Abnormal/anomalous secondary growth occurs in: *(1993)*
a. *Dracaena* b. Ginger
c. Wheat d. Sunflower

102. Commercial cork is obtained from: *(1991)*
a. Berberis/Barberry b. Salix/Willow
c. Quercus/Oak d. Betual/Birch

103. Cork cambium and vascular cambium are: *(1990)*
a. Parts of secondary xylem and phloem
b. Parts of pericycle
c. Lateral meristem
d. Apical meristem

104. Out of diffuse porous and ring porous woods, which is correct? [OS] *(1989)*
a. Ring porous wood carries more water for short period
b. Diffuse porous wood carries more water
c. Ring porous wood carries more water when need is higher
d. Diffuse porous wood is less specialised but conducts water rapidly throughout

105. Cork is formed from: *(1988)*
a. Cork cambium (Phellogen)
b. Vascular cambium
c. Phloem
d. Xylem

106. Which one yields fibres? *(1988)*
a. Coconut b. Oak
c. Teak d. Sisso

107. Organisation of stem apex into corpus and tunica is determined mainly by: [OS] *(1988)*
a. Planes of cell division
b. Regions of meristematic activity
c. Rate of cell growth
d. Rate of shoot tip growth

Answer Key

1. (b)	2. (c)	3. (d)	4. (c)	5. (a)	6. (c)	7. (c)	8. (a)	9. (c)	10. (a)
11. (a)	12. (none)	13. (b)	14. (d)	15. (d)	16. (d)	17. (c)	18. (a)	19. (c)	20. (b)
21. (d)	22. (b)	23. (c)	24. (b)	25. (a)	26. (d)	27. (c)	28. (a)	29. (b)	30. (b)
31. (c)	32. (a)	33. (b)	34. (c)	35. (a)	36. (c)	37. (c)	38. (a)	39. (a)	40. (c)
41. (b)	42. (d)	43. (d)	44. (c)	45. (d)	46. (c)	47. (b)	48. (c)	49. (d)	50. (b)
51. (a)	52. (a)	53. (b)	54. (c)	55. (b)	56. (b)	57. (d)	58. (a)	59. (b)	60. (a)
61. (c)	62. (d)	63. (a)	64. (a)	65. (a)	66. (a)	67. (b)	68. (c)	69. (b)	70. (a)
71. (a)	72. (b)	73. (c)	74. (a)	75. (d)	76. (c)	77. (a)	78. (b)	79. (d)	80. (d)
81. (a)	82. (c)	83. (c)	84. (b)	85. (d)	86. (c)	87. (b)	88. (d)	89. (c)	90. (d)
91. (b)	92. (a)	93. (c)	94. (d)	95. (b)	96. (b)	97. (a)	98. (c)	99. (b)	100. (a)
101. (a)	102. (c)	103. (c)	104. (c)	105. (a)	106. (a)	107. (a)			

Explanations

1. (b) (B), (C) and (D) only.
Secondary or lateral meristem occurs in the mature regions of roots and shoots of many plants and appear later than primary meristem. Fascicular vascular cambium, interfascicular cambium and cork-cambium are examples of lateral meristems.

2. (c) The meristem which occurs between mature tissues is known as intercalary meristem. The meristem that occurs in the mature regions of roots and shoots of many plants is called lateral meristem. E.g., phellogen, intrafascicular cambium and interfascicular cambium.

3. (d) Apical meristem is found at the apices or tips of the plant, both the tip of shoot and the root, and is a region of actively dividing cells. They are present in all the roots.

4. (c) Apical meristem occur at the tips of roots and shoots. During formation of leaves and elongation of stem, some cells left behind from apical meristem and form axillary and terminal bud.

5. (a) Plants produce both leaf and flower primordia cells at the shoot apical meristem. Marginal growth follows the apical growth during leaf primordia growth.

6. (c) Totipotency is the ability of single cell to divide and produce all of the differentiated cells. Meristems in plants are one of the example of totipotent cells. Growth in plants is largely restricted to these specialised regions of active cell division.

7. (c) Collenchyma occurs in dicotyledonous plants. It consists of cells which are much thickened at corners due to deposition of cellulose, hemicellulose & pectin.

8. (a) Lateral meristem (vascular cambium & cork cambium) contribute in secondary growth, i.e., an increase in girth.

9. (c) The tunica corpus concept was given by Schmidt (1924) which was based on plane of divisions of cells.

10. (a) In roots, the protoxylem lies towards periphery and metaxylem lies towards the centre. Such arrangement of primary xylem is called exarch. Endarch and exarch xylem are the terms used for primary xylem.

11. (a) Sclereids are specialised sclerenchyma cells known for their hardness and are commonly found in the fruit walls of nuts. They provide mechanical support and protection.

12. (None)
As per NCERT, all the given statements are correct.

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13. **(b)** In old trees, the greater part of secondary xylem is dark brown due to deposition of organic compounds like tannins, resins, oils, gums, aromatic substances and essential oils in the central or innermost layers of the stem. These substances make it hard, durable and resistant to the attacks of microorganisms and insects.

14. **(d)** Meristematic tissue have cells with active cell division capacity.

Permanent tissues having all cells similar in structure and function are called simple tissue.

Vascular tissue are complex permanent tissues having different types of cells.

Sclereids are sclerenchymatous cells having dead cells with highly thickened walls and narrow lumen.

15. **(d)** The monocotyledonous stem has a sclerenchymatous hypodermis, a large number of scattered vascular bundles, each surrounded by a sclerenchymatous bundle sheath, and a large, conspicuous parenchymatous ground tissue. Vascular bundles are conjoint and closed

16. **(d)** Phloem in gymnosperms lacks both sieve tube and companion cells. Gymosperms have albuminous cells and sieve cells.

17. **(c)** Phellogen cuts off cells on both sides. The outer cells differentiate into cork (phellem) while the inner cells differentiate into secondary cortex (phelloderm). Cells of secondary cortex are parenchymatous. Phellem is made up of dead cells.

18. **(a)** The balloon-shaped structures called tyloses are extensions of xylem parenchyma cells into vessels.

19. **(c)** Tracheids are imperforate while other tracheary elements are perforated.

20. **(b)** Companion cells are closely associated with sieve tube elements.

Mature sieve element possesses a peripheral cytoplasm and a large vacuole but lacks a nucleus. The functions of sieve tubes are controlled by the nucleus of companion cells.

21. **(d)** Gymnosperms are also called soft wood spermatophytes because they lack thick-walled tracheids

22. **(b)** Function of companion cells is loading of sucrose into sieve elements. The sugar formed during photosynthesis process moved in the form of sucrose into the companion cells and then into the living phloem sieve tube cells by active transport.

23. **(c)** The chief water conducting element in gymnosperm is tracheid. While angiosperms have vessels and tracheids as water conducting system.

24. **(b)** Transport of food materials in higher plants takes place through sieve elements.

25. **(a)** Vessel or tracheae are made up of a row of cells, placed one above the other, with their intervening walls absent or variously pored. The walls of vessels are lignified and hard, but not very thick. The cell cavity or the lumen is wide. The thickening may be annular, spiral, scalariform, reticulate and pitted.

26. **(d)** The wall of both vessel elements and sieve tube elements contains pores on lateral walls. The vessels are nucleated whereas the sieve tube elements are enucleated.

27. **(c)** Chlorenchyma are those parenchyma tissue that contains chloroplasts and thus photosynthetic. Apophysis of moss capsule contains chlorenchyma. Due to presence of chloroplast, chlorenchyma have ability to prepare food by photosynthesis.

28. **(a)** Vessels are long cylindrical tube like structures made up of many cells called vessel members, each with lignified walls and a large central cavity. Tracheids are unicellular while vessels are multicellular.

29. **(b)** Xylem vessels are one of the cell types found in xylem, the water conducting tissue of plants. They are typically found in angiosperms but absent from most gymnosperms such as conifers. Xylem vessel is main characteristic distinguishing hardwood of angiosperms from softwood of conifers.

30. **(b)** Hypocotyl is the part of stem of an embryo plant beneath cotyledons and directly above the root. Stems possess collateral bundles with endarch xylem, whereas roots possess radial bundles with exarch xylem. In hypocotyl, transition of exarch bundles of root to endarch bundles of stem takes place.

31. **(c)** Sieve tube elements or sieve cells are elongated cells with tapering end walls. A mature sieve element possess a peripheral cytoplasm and a large vacuole but lacks a nucleus.

32. **(a)** Sclereid, type of sclerenchyma, is spherical oval or cylindrical highly thickened dead cells with narrow cavities.

33. **(b)** Bordered pits are found in vessel wall.

34. **(c)** Mature sieve element possess a peripheral cytoplasm and a large vacuole but it lacks nucleus.

35. **(a)** Angular collenchyma occurs in *Cucurbita*. It has thickening at the angles and there are no intercellular spaces. It is generally found in leaf petioles.

36. **(c)** Collenchyma occurs in layers below epidermis in dicot plants. They provide mechanical support to the growing parts of the plant such as young stem and petiole of a leaf.

37. **(c)** The end walls of sieve tube elements are perforated in a sieve - like manner to form the sieve plates.

38. **(a)** Death of protoplasm is a pre-requisite for a vital functions like transport of sap. Xylem is a dead tissue and do not have protoplasm, xylem performs the function of transport of water or sap inside the plant from roots to leaves.

39. **(a)** Broad-leaved plants have kidney-shaped guard cells whereas those on leaf blades of grasses, such as wheat and bamboo, are dumb-bell shaped.

40. **(c)** Cortex is the region found between epidermis and stele. All tissues on the inner side of the endodermis such as pericycle, vascular bundles and pith constitute the stele.

41. **(b)** A few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells. The stomatal aperture, guard cells and the surrounding subsidiary cells are together called stomatal apparatus.

42. **(d)** In the monocotyledonous, the vascular bundles have no cambium present in them.

43. **(d)** In the monocotyledons, the vascular bundles have no cambium present in them. Hence, since they do not form secondary tissues they are referred to as closed.

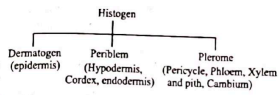
44. **(c)** Water containing cavities in vascular bundles are found in maize (monocot)

45. **(d)** In dicotyledonous stems, cambium is present between phloem and xylem. Such vascular bundles because of the presence of cambium possess the ability to form secondary xylem and phloem tissues, and hence are called open vascular bundles.

46. **(c)** All tissues except epidermis and vascular bundles constitute the ground tissue. It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma.

47. **(b)** Barley stem (monocot) has closed, conjoint and scattered vascular bundles.

48. **(c)**



49. **(d)** A vascular bundle having the phloem and cambium strands on both outer and inner of xylem is called bicollateral.

50. **(b)** Vascular cambium is meristematic layer responsible for cutting off xylem and phloem. The cells cut off towards pith, mature into secondary xylem and cells cut off towards periphery mature into secondary phloem.

51. **(a)** Monocot root

A transverse section showing polyarch, radial, and exarch xylem arrangement, along with the presence of endodermis and pericycle, is characteristic of a monocot root, distinguishing it from dicot roots and stems.

52. **(a)** The initiation of lateral roots and vascular cambium during secondary growth takes place in a few layers of thick-walled parenchymatous cells referred to as pericycle.

53. **(b)** In dicot leaves, vascular bundles are surrounded by large thick-walled cells called bundle sheath cells.

The cells of medullary rays, adjoining intrafascicular cambium become meristematic and form the interfascicular cambium. Thus, a continuous ring of cambium is formed.

Loose parenchyma cells rupturing the epidermis and forming a lens shaped opening in bark called lenticels.

In grasses, certain adaxial epidermal cells along the veins modify themselves into large, empty, colourless cells. These are called bulliform cells.

54. **(c)** In grasses, certain adaxial epidermal cells along the veins modify themselves into large, empty, colourless cells. These are called bulliform cells.

55. **(b)** Bulliform cells become flaccid due to water stress. This will make the leaves to curl inward to minimise water loss

56. **(b)** Vascular cambium is located between the xylem and phloem in the stem and root of a vascular plant. It is the source of both the secondary xylem growth (inwards, towards pith) and secondary phloem growth (outwards).

57. **(d)** Casparian strip is a band of cell wall material deposited in the radial and transverse walls of the endodermis. It is made up of suberin and lignin.

58. **(a)** In monocotyledonous plants, the vascular bundles have no cambium present in them. Hence, since they do not form secondary tissues they are referred to as closed. Scatter vascular bundles are characteristic of monocot stem, not root.

59. **(b)** Monocot root contain many xylem bundles called polyarch condition.

60. **(a)** Dicot root has exarch, radial vascular bundles. On the other hand, dicot stem has conjoint, endarch vascular bundles.

61. **(c)** Mesophyll is well differentiated into palisade and spongy parenchyma in dicot leaf. While monocot leaf do not have such differentiation. *Sorghum* is monocot while rest three are dicot.

62. **(d)** Passage cells or transfusion tissue found in the endodermis of roots facilitate the rapid transport of water from cortex to pericycle.

63. **(a)** In dicotyledonous roots, there are usually 2-4 xylem & phloem patches (or vascular bundles). There usually more than six (polyarch) xylem bundles in monocot root.

64. **(a)** In plant anatomy, casparian strip is a band of cell wall material deposited in the radial & transverse walls of endodermis.

65. **(a)** Fruits are derived from flowers, hence, the plant is an angiosperm. Monocots have adventitious roots, whereas dicots have a radicle from which a root develops (called tap root system).

66. **(a)** Tangential as well as radial walls of endodermal cells have a deposition of water - impermeable, waxy material - suberin - in form of casparian strips.

67. **(b)** Casparian strip is a band of cell wall material deposited in radial and transverse walls of endodermis.

68. **(c)** In isobilateral (monocot) leaf, the stomata are present on both the surface of the epidermis; and the mesophyll is not differentiated into palisade and bulliform cells from epidermis are characteristic feature of monocot leaf.

69. **(b)** Initiation of lateral roots and vascular cambium during the secondary growth takes place in thick-walled parenchymatous pericycle.

70. **(a)** Monocot leaves possess intercalary meristem. Intercalary meristem are responsible for localised growth.

71. **(a)** Pith and cortex do not differentiate in monocot stem. Since numerous vascular bundles lie scattered, the ground tissue system in a monocot stem is distinguishable into hypodermis and ground parenchyma.

72. **(b)** In winter, the cambium is less active and forms fewer xylary elements that have narrow vessels, and this wood is called autumn wood or late wood.

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73. **(c)** Bark is a non-technical term that refers to all tissues exterior to the vascular cambium, therefore including secondary phloem. Bark refers to a number of tissue types, viz., periderm and secondary phloem. Bark that is formed early in the season is called early or soft bark. Towards the end of the season, late or hard bark is formed. Lenticels permit the exchange of gases between the outer atmosphere and the internal tissue of the stem. Meristematic tissue called cork cambium or phellogen develops, usually in the cortex region. Phellogen is a couple of layers thick.

74. **(a)** The correct sequence of the tissues in the stelar region of a stem showing secondary growth, from the pith toward the cortex, is as follows:

Primary Xylem

Secondary Xylem

Secondary Phloem

Primary Phloem

75. **(d)** Two vascular bundles

The interfascicular cambium is found between two vascular bundles. It forms part of the vascular cambium during secondary growth in plants.

76. **(c)** In the spring season, cambium is very active and produces a large number of xylary elements having vessels with wider cavities. The wood formed during this season is called spring wood or early wood. It is lighter in colour and has a lower density. The two kinds of woods, springwood and autumnwood, appear as alternate concentric rings and constitute an annual ring.

77. **(a)** Lenticels are lens-shaped openings that permit the exchange of gases between the outer atmosphere and the internal tissue of the stem.

Cork cambium is also known as phellogen.

Phelloderm is also known as secondary cortex because it develops during secondary growth.

The cork is impermeable to water due to suberin deposition in the cell wall.

78. **(b)** In old trees, the central or innermost part of secondary xylem is dark brown due to deposition of organic compounds like tannins, resins, oils, gums, aromatic substances and essential oils. This region comprises dead elements with highly lignified walls called as heartwood.

The peripheral region (outermost) of the secondary xylem is lighter in colour and is known as the sapwood.

79. **(d)** Cork cambium or phellogen cuts off cells on both sides. The outer cells differentiate into cork or phellem while the inner cells differentiate into secondary cortex or phelloderm. It forms secondary cortex on its innerside.

80. **(d)** Annual rings are formed by the seasonal activity of cambium. In temperate regions, climatic conditions are not uniform throughout the year. However in tropics climatic conditions are uniform throughout the year. Therefore, in plants of temperate regions, cambium is more active in spring and less active in autumn seasons.

81. **(a)** Monocots either have no secondary growth or they ha an anomalous secondary growth such as in grass. It happe because of the absence of cambium between xylem a phloem in monocots.

82. **(c)** During secondary growth, vascular cambium gives ri to secondary xylem and secondary phloem. Phelloderm formed by cork cambium.

83. **(c)** **Heartwood:** It is the hard, dead, dark brown-colour highly lignified and non-functional central part of secondary xylem of old trees. The dark colour is due deposition of organic compounds (tannins, resins, oil gums, aromatic substances, essential oils, etc). Thes substances make it hard, durable and resistant to the attack of microorganisms and insects. The heartwood does no conduct water but it gives mechanical support to the stem.

84. **(b)** Phellem - Secondary cortex - Secondary phloem - Wood

85. **(d)** Dicot stem is endarch while dicot root is exarch. Anatomically protoxylem distinguished them.

86. **(c)** Lenticels, a lens-shaped opening, permit the exchange o gases between the outer atmosphere and the internal tissue of the stem. These occur in most woody trees.

87. **(b)** In dicot stems, the cells of cambium present between primary xylem and primary phloem are the intrafascicular cambium. The cells of medullary rays, adjoining these intrafascicular cambium become meristematic and form the interfascicular cambium.

Xylem parenchyma is living and thin-walled and their cell walls are made up of cellulose.

In dicot roots, the innermost layer of the cortex is called endodermis.

Next to endodermis lie a few layers of thin-walled parenchymatous cells called as pericycle.

88. **(d)** No. of annual ring = No. of year

89. **(c)** Phellogen cuts off cells on both sides. The outer cells differentiate into cork or phellem (common bottle cork) while the inner cells differentiate into secondary cortex or phelloderm.

90. **(d)** Phellogen, phellem, and phelloderm are collectively known as periderm.

91. **(b)** Heart wood constitutes greatest part of secondary xylem. It is dark brown due to deposition of tannins, resins, oil and gum. These substances make them hard, durable and resistant to pests and pathogens. It comprises of dead elements with highly lignified walls. It does not conduct water but gives mechanical support to the stem.

92. **(a)** Secondary growth is well observed in dicots of angiosperms. Teak (angiosperm) and pine (gymnosperm) ha a wooden stem because it has a continuous growth in the diameter due to cambium, forming secondary wood (xylem phloem).

93. **(c)** Lenticels permit the exchange of gases between the outer atmosphere & internal tissue of the stem. Occur in most woody trees.

94. **(d)** Diffuse porous wood occurs when the pores are distributed evenly throughout the wood. It is common in many tropical species.

95. **(b)** Vascularisation is a general requirement for growth of plant tumors. Formation of vascular tissues (phloem & xylem) takes place after the development of procambium.

96. **(b)** The outer cells of phellogen or cork cambium differentiate into cork or phellem while the inner cells differentiate into secondary cortex or phelloderm.

97. **(a)** In old trees, the greater part of secondary xylem is dark brown and comprises dead elements with highly lignified walls and is called heart wood. It gives mechanical support to the stem.

98. **(c)** As stem continues to grow in girth due to activity of vascular cambium, meristematic tissue called phellogen develops. Phellogen cuts off cells on both sides, outer cells differentiate into phellem while inner cells into phelloderm. Phellogen, phellem and phelloderm are collectively known as periderm.

99. **(b)** Bark is exterior to vascular cambium.

100. **(a)** Peripheral region of secondary xylem is called sapwood. It is involved in conduction of water & minerals from root to leaf. Sapwood is soft and living, thus will decay faster.

101. **(a)** Plants like *Dracaena* show secondary growth by a special cambium.

102. **(c)** An oak is a tree or shrub in the genus *Quercus*. The bark of the cork oak is used to produce corks.

103. **(c)** Tissue involved in secondary growth are the two lateral meristems: vascular cambium & cork cambium.

104. **(c)** Ring porous wood carries more water when need is higher. Ring porous wood provides better translocation when requirement of plant is more. Hence, it is very advanced than diffuse porous wood.

105. **(a)** Cork cambium or phellogen cuts off cells on both sides. Outer cells differentiate into cork.

106. **(a)** The coconut is a good fruit because it contains a rich source of fiber and fat. Coconut fibre is one of the highest and best sources of dietary fibre.

107. **(a)** Almost all flowering plants have tunica - corpus organisation. Tunica & corpus, two tissue zones in shoot apex, are concerned with planes of cell division. Tunica is peripheral tissue & corpus is inner tissue zone of shoot apex.

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Structural Organisation in Animals

Epithelial & Connective Tissue

1. Given below are two statements: *(2023)*
Statement I: Ligaments are dense irregular tissue
Statement II: Cartilage is dense regular tissue.
In the light of above statements choose the correct answer from the option given below:
a. Statement I is false but Statement III is true.
b. Both Statement I and II are true
c. Both Statement I and II are false
d. Statement I is true but Statement II is false

2. Match List-I with List-II. [MR^a] *(2023)*

List-I		List-II	
(A)	Mast cells	(I)	Ciliated epithelium
(B)	Inner surface of bronchiole	(II)	Areolar connective tissue
(C)	Blood	(III)	Cuboidal epithelium
(D)	Tubular parts of nephron	(IV)	specialised connective tissue

Choose the correct answer from the options
a. A-III, B-IV, C-II, D-I b. A-I, B-II, C-IV, D-III
c. A-II, B-III, C-I, D-IV d. A-II, B-I, C-IV, D-III

3. Given below are two statements: *(2023-Manipur)*
Statement I: Goblet cells are unicellular glands.
Statement II: Earwax is the secretion of exocrine gland.
In the light of the above statements, choose the **correct** answer from the options given below:
a. **Statement I** is true but **Statement II** is false
b. **Statement I** is false but **Statement II** is true
c. Both **Statement I** and **Statement II** are true
d. Both **Statement I** and **Statement II** are false.

4. Match **List-I** with **List-II**. [MR^a] *(2023-Manipur)*

List-I		List-II	
(A)	Columnar epithelium	(I)	Ducts of glands
(B)	Ciliated epithelium	(II)	Inner lining of stomach and intestine
(C)	Squamous epithelium	(III)	Inner lining of bronchioles
(D)	Cuboidal epithelium	(IV)	Endothelium

Choose the **correct** answer from the options given below:
a. A-III, B-II, C-I, D-IV b. A-III, B-II, C-IV, D-I
c. A-II, B-III, C-I, D-IV d. A-II, B-III, C-IV, D-I

5. Which of the following types of epithelium is present in the bronchioles and Fallopian tubes? *(2022 Re)*
a. Stratified squamous epithelium
b. Simple squamous epithelium
c. Simple columnar epithelium
d. Ciliated epithelium

6. Choose the correct statements: *(2022 Re)*
A. Bones support and protect softer tissues and organs
B. Weight bearing function is served by limb bones
C. Ligament is the site of production of blood
D. Adipose tissue is specialised to store fats.
E. Tendons attach one bone to another.
Choose the most appropriate answer from the options given below
a. (A), (B) and (E) only b. (A), (B) and (D) only
c. (B), (C) and (E) only d. (A), (C) and (D) only

7. Which of the following is present between the adjacent bones of the vertebral column? *(2022)*
a. Smooth muscle b. Intercalated discs
c. Cartilage d. Areolar tissue

8. Which of the following is not a connective tissue? *(2022)*
a. Neuroglia b. Blood
c. Adipose tissue d. Cartilage

9. Match List-I with List-II. [MR^a] *(2022)*

List-I		List-II	
(A)	Bronchioles	(i)	Dense Regular Connective Tissue
(B)	Goblet cell	(ii)	Loose Connective Tissue
(C)	Tendons	(iii)	Glandular Tissue
(D)	Adipose Tissue	(iv)	Ciliated Epithelium

Choose the correct answer from the options given below.
a. A-iii B-iv C-ii D-i
b. A-iv B-iii C-i D-ii
c. A-i B-ii C-iii D-iv
d. A-ii B-i C-iv D-iii

10. Identify the types of cell junctions that help to stop the leakage of the substances across a tissue and facilitation of communication with neighbouring cells via rapid transfer of ions and molecules. [MR^a] *(2021)*
a. Tight junctions and Gap junctions, respectively.
b. Adhering junctions and Tight junctions, respectively.
c. Adhering junctions and Gap junctions, respectively.
d. Gap junctions and Adhering junctions, respectively.

11. Cuboidal epithelium with brush border of microvilli is found in: *(2020)*
a. Ducts of salivary glands
b. Proximal convoluted tubule of nephron
c. Eustachian tube
d. Lining of intestine

12. Goblet cells of alimentary canal are modified from: *(2020)*
a. Columnar epithelial cells
b. Chondrocytes
c. Compound epithelial cells
d. Squamous epithelial cells

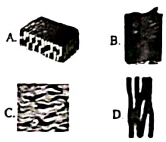
13. The ciliated epithelial cells are required to move particles or mucus in a specific direction. In humans, these cells are mainly present in *(2019)*
a. Bile duct and bronchioles
b. Fallopian tubes and pancreatic duct
c. Eustachian tube and salivary duct
d. Bronchioles and fallopian tubes

14. The function of the gap junction is to: *(2015 Re)*
a. Facilitate communication between adjoining cells by connecting the cytoplasm for rapid transfer of ions, small molecules and some large molecules
b. Separate two cells from each other
c. Stop substance from leaking across a tissue
d. Performing cementing to keep neighboring cells together.

15. Choose the correctly matched pair: *(2014)*
a. Cartilage - Loose connective tissue
b. Tendon - Specialised connective tissue
c. Adipose tissue - Dense connective tissue
d. Areolar tissue - Loose connective tissue

16. Choose the correctly matched pair: *(2014)*
a. Inner surface of bronchioles - Squamous epithelium
b. Inner lining of salivary ducts - Ciliated epithelium
c. Moist surface of Buccal cavity - Glandular epithelium
d. Tubular parts of nephrons - Cuboidal epithelium

17. The four sketches (A, B, C and D) given below, represent four different types of animal tissues. Which one of these is correctly identified in the options given, along with its correct location and function? [MR^a] *(2012 Mains)*



		Tissue	Location	Function
a.	(B)	Glandular epithelium	Intestine	Secretion
b.	(C)	Collagen fibres	Cartilage	Attach skeletal muscles to bones
c.	(D)	Smooth muscle tissue	Heart	Heart contraction
d.	(A)	Columnar epithelium	Nephron	Secretion and absorption

18. Given below is the diagrammatic sketch of a certain type of connective tissue. Identify the parts labeled A, B, C and D and select the right option about them. *(2012 Mains)*

	Part - A	Part - B	Part - C	Part - D
a.	Macrophage	Fibroblast	Collagen fibres	Mast cells
b.	Mast cell	Macro-Phage	Fibroblast	Collagen fibres
c.	Macrophage	Collagen fibres	Fibroblast	Mast cell
d.	Mast cell	Collagen fibres	Fibroblast	Macrophage

19. The supportive skeletal structures in the human external ears and in the nose tip are examples of: *(2012 Mains)*
a. Ligament b. Areolar tissue
c. Bone d. Cartilage

20. The cells lining the blood vessels belong to the category of: *(2011 Mains)*
a. Columnar epithelium b. Connective tissue
c. Smooth muscle tissue d. Squamous epithelium

21. The ciliated columnar epithelial cells in humans are known to occur in: *(2011 Pre)*
a. Fallopian tubes and urethra
b. Eustachian tube and stomach lining
c. Bronchioles and Fallopian tubes
d. Bile duct and oesophagus

22. Lining layer of fallopian tubes, nasal passages, bronchi and bronchioles consists of: *(2009)*
a. Squamous columnar epithelium
b. Ciliated columnar epithelium
c. Stratified columnar epithelium
d. Cubical epithelium

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23. The supportive structure of our pinna is also found in: *(2009)*
a. Tip of nose b. Ear ossicles
c. Vertebrae d. Nails

24. Cell junctions called tight, adhering and gap junctions are found in: *(2009)*
a. Neural tissue b. Muscular tissue
c. Connective tissue d. Epithelial tissue

25. Cell junctions will be frequent in: *(2007)*
a. Thrombocytes b. Tendon
c. Hyaline cartilage d. Ciliated epithelium

26. Areolar tissue joins: *(2006)*
a. Integument with muscles
b. Bones with muscles
c. Bone with bone
d. Fat body with muscles

27. Which one of the following contains the largest quantity of extracellular material? **[OS]** *(2003)*
a. Striated muscle b. Areolar tissue
c. Stratified epithelium d. Myelinated nerve fibres

28. Which cartilage is present at the end of long bones? **[OS]** *(2002)*
a. Calcified cartilage b. Hyaline cartilage
c. Elastic cartilage d. Fibrous cartilage

29. What will happen if ligaments are cut or broken? *(2002)*
a. Bones will move freely at joints
b. No movement at joint
c. Bone will become unfix
d. Bone will become fixed

30. During an injury, nasal septum gets damaged and for it's recovery which cartilage preferred? **[OS]** *(2001)*
a. Elastic cartilage b. Hyaline cartilage
c. Calcified cartilage d. Fibrous cartilage

31. Characteristic of simple epithelium is: *(2000)*
a. They are arranged indiscriminately
b. They make a definite layer
c. Continue to divide and help in organ function
d. None of the above

32. Ligament consist of: **[OS]** *(1999)*
a. Yellow fibres + Elastic fibres
b. Yellow fibres + Collagen (white) fibres
c. Yellow fibres + Muscle fibres
d. White fibres + Muscle fibres

33. Tendon consist of: **[OS]** *(1999)*
a. Non-Elastic connective tissue
b. White Elastic tissue
c. Collagen (white) fibres + Muscle fibres
d. Only collagen fibres

34. Protein present in cartilage is: **[OS]** *(1997)*
a. Cartilagin b. Ossein
c. Chondrin d. None of these

35. Basement membrane is made up of: **[OS]** *(1997)*
a. No cell product of epithelial cell
b. Epidermal cell only
c. Endodermal cell
d. Both (b) and (c)

36. Stratum germinativum is an example of which kind of epithelium? **[OS]** *(1997)*
a. Columnar b. Squamous
c. Cuboidal d. Ciliated

37. An epithelial tissue which has thin flat cells, arranged edge to edge so as to appear like closely packed tiles, is found to be present at: *(1994)*
a. Outer surface of ovary b. Inner lining of fallopian tube
c. Inner lining of stomach d. Inner lining of cheeks

38. Hair present in the skin are: **[OS]** *(1993)*
a. Epidermal in origin and made of dead cells
b. Epidermal in origin and made of living cells
c. Dermal in origin and made of living cells
d. Dermal in origin and made of lead cells

39. Formation of cartilage bones involves: **[OS]** *(1993)*
a. Deposition of bony matter by osteoblasts and resorption by chondroclasts
b. Deposition of bony matter by osteoclasts
c. Deposition of bony matter by osteoclasts only
d. Deposition of bony matter by osteoblasts only

40. Haversian canals occur in: **[OS]** *(1989)*
a. Humerus b. Pubis
c. Scapula d. Clavicle

41. Histamine secreting cells are found in: **[OS]** *(1989)*
a. Connective tissues b. Lungs
c. Muscular tissue d. Nervous tissue

42. Mineral found in red pigment of vertebrate blood is: **[OS]** *(1989)*
a. Magnesium b. Iron
c. Calcium d. Copper

43. Extremities of long bones possess which of the following cartilages? *(1989)*
a. Calcified b. Fibrous
c. Elastic d. Hyaline

Muscle Tissue & Neural Tissue

44. Choose the correct statement about a muscular tissue: *(2022 Re)*
a. Smooth muscles are multinucleated and involuntary.
b. Skeletal muscle fibres are uninucleated and found in parallel bundles.
c. Intercalated discs allow the cardiac muscle cells to contract as a unit.
d. The walls of blood vessels are made up of columnar epithelium.

45. Which of the following statements **wrongly** represents the nature of smooth muscle? *(2021)*
a. They are involuntary muscles
b. Communication among the cells is performed by intercalated discs
c. These muscles are present in the wall of blood vessels
d. These muscle have no striations

46. Select the **Incorrectly** matched pair from following: *(2020-Covid)*
a. Neurons - Nerve cells
b. Fibroblast - Areolar tissue
c. Osteocytes - Bone cells
d. Chondrocytes - Smooth muscle cells

47. Smooth muscles are: *(2016 - II)*
a. Involuntary, cylindrical, striated
b. Voluntary, spindle–shaped, uninucleate
c. Involuntary, fusiform, non-striated
d. Voluntary, multinucleate, cylindrical

48. Which type of tissue correctly matches with its location? **[OS]** *(2016 - I)*

	Tissue	Location
a.	Smooth muscle	Wall of intestine
b.	Areolar tissue	Tendons
c.	Transitional epithelium	Tip of nose
d.	Cuboidal epithelium	Lining of stomach

49. Which of the following is not a function of the skeletal system? *(2015 Re)*
a. Storage of minerals
b. Production of body heat
c. Locomotion
d. Production of erythrocytes

50. The type of muscles present in our: *(2011 Mains)*
a. Thigh are striated and voluntary
d. Upper arm are smooth muscle fibers fusiform in shape
c. Heart are involuntary and unstriated smooth muscles
d. Intestine are striated and involuntary

51. Which is correctly paired? *(2009)*
a. Heart - Involuntary, unstriated muscle
b. Iris - Involuntary, smooth muscle
c. Biceps - Smooth muscle
d. Abdominal wall - Smooth muscle

52. Which pair of structures distinguishes a nerve cell from other cells? *(2007)*
a. Vacuole and fibres
b. Nucleus and mitochondria
c. Perikaryon and dendrites
d. Flagellum and medullary sheath

53. Which cells do not form layer and remains structurally separate? *(2001)*
a. Epithelial cells b. Muscle cells
c. Nerve cells d. Gland cells

54. Which part does not have only involuntary muscles? *(1998)*
a. Urethra b. Iris
c. Heart muscles d. Blood vessels

55. Characteristics of smooth muscle fibres are: *(1992)*
a. Spindle-shaped, unbranched, non-striated, uninucleate and involuntary
b. Spindle-shaped, unbranched, unstriped, multinucleate and involuntary
c. Cylindrical, unbranched, unstriped, multinucleate and voluntary
d. Cylindrical, unbranched, striated, multinucleate and voluntary

Cockroach

56. Which of the following is characteristic feature of cockroach regarding sexual dimorphism?
a. Presence of anal cerci
b. Dark brown body colour and anal cerci
c. Presence of anal styles
d. Presence of sclerites

57. In cockroach, excretion is brought about
A. Phallic gland
B. Urecose gland
C. Nephrocytes
D. Fat body
E. Collaterial glands
Choose the correct answer from the options given below:
a. B and D only b. A and E only
c. A, B and E only d. B, C and D only

58. The Cockroach is: *(2023-Manipur)*
a. Ammonotelic only b. Uricotelic only
c. Ureotelic only d. Ureotelic and Uricotelic

59. Given below are two statements: *(2023-Manipur)*
Statement I: In cockroach, the forewings are transparent and prothoracic in origin.
Statement II: In cockroach, the hind wings are opaque, leathery and mesothoracic in origin.
In the light of the above statements, choose the **correct** answer from the options given below:
a. **Statement I** is correct but **Statement II** is incorrect
b. **Statement I** is incorrect but **Statement II** is correct
c. Both **Statement I** and **Statement II** are correct
d. Both **Statement I** and **Statement II** are incorrect

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60. Match List-I with List-II regarding the organs of Cockroach: *(2022 Re)*

List-I		List-II	
(A)	Crop	(I)	grinding the food particles
(B)	Proventriculus	(II)	secretion of digestive juice
(C)	Hepatic caeca	(III)	removal of nitrogenous waste
(D)	Malpighian tubules	(IV)	storage of food

Choose the correct answer from the options given below.

a. A-I, B-IV, C-III, D-II
b. A-IV, B-I, C-II, D-III
c. A-III, B-II, C-I, D-IV
d. A-II, B-IV, C-I, D-III

61. Excretion in cockroach is performed by all, EXCEPT: *(2022 Re)*

a. Hepatic caeca b. Urecose glands
c. Malpighian tubules d. Fat body

62. Tegmina in cockroach, arises from *(2022)*

a. Prothorax and Mesothorax
b. Prothorax
c. Mesothorax
d. Metathorax

63. Which of the following characteristics is **incorrect** with respect to cockroach? **[MR*]** *(2021)*

a. Hypopharynx lies within the cavity enclosed by the mouth parts.
b. In females, 7th - 9th sterna together form a genital pouch.
c. 10th abdominal segment in both sexes, bears a pair of anal cerci.
d. A ring of gastric caeca is present at the junction of midgut and hind gut.

64. If the head of cockroach is removed, it may live for few days because: *(2020)*

a. The cockroach does not have nervous system.
b. The head holds a small proportion of a nervous system while the rest is situated along the ventral part of its body.
c. The head holds a 1/3rd of a nervous system while the rest is situated along the dorsal part of its body.
d. The supra-oesophageal ganglia of the cockroach are situated in ventral part of abdomen.

65. In cockroach, identify the parts of the foregut in correct sequence: *(2020-Covid)*

a. Mouth → Crop → Pharynx → Oesophagus → Gizzard
b. Mouth → Gizzard → Crop → Pharynx → Oesophagus
c. Mouth → Pharynx → Oesophagus → Crop → Gizzard
d. Mouth → Oesophagus → Pharynx → Crop → Gizzard

66. Match the following columns with reference to ... and select the correct option: *(2020...*

	Column-I		Column-II
1.	Grinding of the food particles	(i)	Hepatic caeca
2.	Secrete gastric juice	(ii)	10th segment
3.	10 pairs	(iii)	Proventriculus
4.	Anal cerci	(iv)	Spiracles
		(v)	Alary muscles

	(1)	(2)	(3)	(4)
a.	(iv)	(iii)	(v)	(ii)
b.	(i)	(iv)	(iii)	(ii)
c.	(ii)	(iii)	(i)	(iv)
d.	(iii)	(i)	(iv)	(ii)

67. Select the correct sequence of organs in the alimentary ... of cockroach starting from mouth

a. Pharynx → Oesophagus → Crop → Gizzard → ... Colon → Rectum
b. Pharynx → Oesophagus → Gizzard → Crop → ... Colon → Rectum
c. Pharynx → Oesophagus → Gizzard → Ileum → ... Colon → Rectum
d. Pharynx → Oesophagus → Ileum → Crop → ... Colon → Rectum

68. Which of the following features is used to identify ... cockroach from a female cockroach?

a. Presence of a boat shaped sternum on the 9th ... segment
b. Presence of caudal styles
c. Forewings with darker tegmina
d. Presence of anal cerci

69. In male cockroaches, sperms are stored in which part ... reproductive system? *(201...*

a. Testes b. Vas deferens
c. Seminal vesicles d. Mushroom glands

70. Which of the following features is not present in *Peripl... americana*? **[OS]** *(201...*

a. Schizocoelom as body cavity
b. Indeterminate and radial cleavage during embr... development
c. Exoskeleton composed of N-acetyl glucosamine
d. Metamerically segmented body

71. The terga, sterna and pleura of cockroach body are ... by:

a. Arthrodial membrane b. Cartilage
c. Cementing glue d. Muscular tissue

72. The body cells in cockroach discharge their nitrog... waste in the haemolymph mainly in the form of: **[OS]** *(20...*

a. Potassium urate b. Urea
c. Calcium carbonate d. Ammonia

73. Select the correct option with respect to cockroaches: *(2013)*

a. Malpighian tubules convert nitrogenous wastes into urea
b. Males bear short anal styles not present in females
c. Nervous system comprises of a dorsal nerve cord and ten pairs of ganglia
d. The forewings are tegmina which are used in flight

74. What external changes are visible after the last moult of a cockroach nymph? **[OS]** *(2013)*

a. Labium develops
b. Mandibles become harder
c. Anal cerci develop
d. Both fore wings and hind wings develop

75. Select the correct statement from the ones given below with respect to *Periplaneta americana:* *(2012 Pre)*

a. Grinding of food is carried out only by the mouth parts
b. Nervous system located dorsally, consists of segmentally arranged ganglia joined by a pair of longitudinal connectives
c. Males bear a pair of short thread like anal styles
d. There are 16 very long Malpighian tubules present at the junctions of midgut and hindgut

76. Which of the following is correctly stated as happens in the common cockroach? *(2011 Pre)*

a. The food is ground by mandibles and gizzard
b. Malpighian tubules are excretory organ projecting out from the colon
c. Oxygen is transported by haemoglobin blood
d. Nitrogenous excretory product is urea

77. Male cockroach can be identified from the female by the presence of: *(2010 Mains)*

a. Long antennae b. Wingless body
c. Elongated abdomen d. Anal styles

78. Ommatidia serve the purpose of photoreception in: *(2003)*

a. Cockroach b. Frog
c. Humans d. Sunflower

79. Male and female cockroaches can be distinguished externally through: *(1991)*

a. Anal styles in male
b. Anal cerci in female
c. Anal style and antennae in females
d. Both (b) and (c)

Frog

80. Select the correct route for the passage of sperms in male frogs: *(2017-Delhi)*

a. Testes → Bidder's canal → Kidney → Vasa efferentia → Urinogenital duct → Cloaca
b. Testes → Vasa efferentia → Kidney → Seminal Vesicle → Urinogenital duct → Cloaca
c. Testes → Vasa efferentia → Bidder's canal → Ureter → Cloaca
d. Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca

81. Frog's heart when taken out of the body continues to beat for some time **[MR*]** *(2017-Delhi)*

Select the best option from the following statements

A. Frog is a poikilotherm
B. Frog does not have any coronary circulation
C. Heart is "myogenic" in nature
D. Heart is autoexcitable

a. Only (A) b. Only (D)
c. (A) & (B) d. (C) & (D)

82. Which one of the following characteristics is common both in humans and adult frogs? *(2012 Mains)*

a. Four-chambered heart b. Internal fertilisation
c. Nucleated RBCs d. Ureotelic mode of excretion

83. Compared to those of humans, the erythrocytes in frog are: *(2012 Pre)*

a. Nucleated and without haemoglobin
b. Without nucleus but with haemoglobin
c. Nucleated and with haemoglobin
d. Very much smaller and fewer

84. Consider the following four statements (A-D) related to the common frog *Rana tigrina*, and select the correct option stating which ones are true (T) and which ones are false (F). *(2011 Mains)*

Statements:

A. On dry land it would die due to lack of O_2 if its mouth is forcibly kept closed for a few days.
B. It has four chambered heart.
C. On dry land it turns uricotelic from ureotelic.
D. Its life history is carried out in pond water.

Options:

	(A)	(B)	(C)	(D)
a.	F	F	T	T
b.	F	T	T	F
c.	T	F	F	T
d.	T	T	F	F

85. Frogs differ from humans in possessing: *(2011 Mains)*

a. Nucleated red blood cells
b. Thyroid as well as parathyroid
c. Paired cerebral hemispheres
d. Hepatic portal system

86. Ureters act as urinogenital ducts in: *(2011 Mains)*

a. Frog's both males and females
b. Frog's males
c. Human males
d. Human females

87. What happens if bone of frog is kept in dilute hydrochloric acid? **[OS]** *(2000)*

a. Will become flexible b. Will turn black
c. Will break in pieces d. Will shrink

88. The roof of the cranium of frog is formed by: **[OS]** *(1997)*

a. Frontoparietal b. Orbitosphenoid
c. Parasphenoid d. Alisphenoid

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89. In frog, the surface of attachment of tongue is: [OS] *(1997)*
a. Pterygoid b. Hyoid apparatus
c. Parasphenoid d. Palatine

90. In frog, "fenestra ovalis" is: [OS] *(1997)*
a. The communication between the pharynx and the tympanic cavity
b. The external opening of the tympanic cavity which is covered by the tympanic membrane
c. The air filled cavity of the middle ear
d. The opening in the auditory capsule which separates the middle ear from the internal ear

91. The kidney of an adult frog is: *(1997)*
a. Metanephros b. Opisthonephros
c. Pronephros d. Mesonephros

92. Mucus helps frog in [illegible]
a. Thick skin b. Dry skin
c. Smooth skin d. Moist skin

93. The layer of actively dividing cells in skin of frog is known as: [OS]
a. Stratum compactum
b. Stratum corneum
c. Stratum malpighii/stratum germinativum
d. Stratum lucidum

94. Nitrogenous waste products are eliminated mainly [illegible]
a. Urea in tadpole and ammonia in adult frog
b. Ammonia in tadpole and urea in adult frog
c. Urea in both tadpole and adult frog
d. Urea in tadpole and uric acid in adult frog

Answer Key

1. (c)	2. (a)	3. (c)	4. (d)	5. (d)	6. (b)	7. (c)	8. (a)	9. (b)	10. (a)
11. (b)	12. (a)	13. (d)	14. (a)	15. (d)	16. (d)	17. (a)	18. (a)	19. (d)	20. (d)
21. (c)	22. (b)	23. (a)	24. (d)	25. (d)	26. (a)	27. (b)	28. (b)	29. (c)	30. (b)
31. (b)	32. (b)	33. (d)	34. (c)	35. (a)	36. (a)	37. (d)	38. (a)	39. (a)	40. (a)
41. (a)	42. (b)	43. (d)	44. (c)	45. (b)	46. (d)	47. (c)	48. (a)	49. (b)	50. (a)
51. (b, d)	52. (c)	53. (c)	54. (a)	55. (a)	56. (c)	57. (d)	58. (b)	59. (d)	60. (b)
61. (a)	62. (c)	63. (d)	64. (b)	65. (c)	66. (d)	67. (a)	68. (b)	69. (c)	70. (b)
71. (a)	72. (a)	73. (b)	74. (d)	75. (c)	76. (a)	77. (d)	78. (a)	79. (a)	80. (d)
81. (d)	82. (d)	83. (c)	84. (c)	85. (a)	86. (b)	87. (a)	88. (a)	89. (b)	90. (c)
91. (d)	92. (d)	93. (c)	94. (b)						

Explanations

1. (c) Ligaments are dense regular connective tissue that connect bone to bone. Cartilage is one of the types of specialised connective tissues.

2. (d) Mast cells – Areolar tissue serve as support frame work for epithelium.

Inner surface of Bronchiole – Ciliated epithelium bear cilla on their free surface that help to move particles in specific direction.

Blood – Specialised connective tissues.

Tubular parts of nephrons – Cuboidal epithelium help in secretion and absorption.

3. (c) Both Statement I and Statement II are true.

Goblet cells are unicellular glands that secrete mucus to protect and lubricate many internal surfaces of the body. Earwax is produced by exocrine glands in the ear canal.

4. (d) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

(A) Columnar epithelium - (II) Inner lining of stomach intestine

(B) Ciliated epithelium -(III) Inner lining of bronchioles

(C) Squamous epithelium -(IV) Endothelium

(D) Cuboidal epithelium -(I) Ducts of glands

5. (d) The type of epithelium present in the bronchioles fallopian tubes is ciliated epithelium, which helps in mo mucus out of the bronchioles and in moving the egg tow the uterus in the fallopian tubes.

6. (b) Tendons and ligaments are both dense regular connec tissues. Tendons attach muscles to bones, while ligam connect one bone to another.

7. (c) Cartilage is a type of specialised connective tissue. The intercellular material of cartilage is solid and pliable and resists compression. Cartilage is present in the tip of nose, outer ear joints, between adjacent bones of the vertebral column, limbs and hands in adults.

The smooth muscle fibres taper at both ends (fusiform) and do not show striations. The wall of internal organs such as the blood vessels, stomach and intestine contains this type of muscle tissue.

Communication junctions (intercalated discs) at some fusion points allow the cells to contract as a unit, i.e., when one cell receives a signal to contract, its neighbours are also stimulated to contract.

Areolar tissue is present beneath the skin.

8. (a) Neuroglia is a neural tissue. It makes up more than one-half the volume of neural tissue in our body.

Blood and cartilage are specialized connective tissue.

Adipose tissue is a type of loose connective tissue located mainly beneath the skin.

9. (b) Ciliated Epithelium is found in bronchioles. Glandular tissue is present in goblet cells. Tendons are a part of dense regular connective tissue. Loose connective tissue includes adipose tissue.

10. (a) Tight junctions help to stop substances from leaking across a tissue. Adhering junctions perform cementing to keep neighbouring cells together. Gap junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

11. (b) The cuboidal epithelium of proximal convoluted tubule (PCT) of nephron in the kidney has microvilli.

12. (a) Mucosal epithelium of the alimentary canal has goblet cells which secrete mucus that help in lubrication. These are modified from columnar epithelial cells.

13. (d) Bronchioles and fallopian tubes are lined with ciliated epithelium to move particles or mucus in a specific direction over the epithelium.

14. (a) Gap junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

15. (d) Tendon - Dense connective tissue

Cartilage - Specialised connective tissue

Adipose tissue and Areolar tissue- Loose connective tissue

16. (d) Tubular part of nephron – Cuboidal epithelium.

Moist surface of buccal cavity & inner lining of salivary ducts – Compound epithelium

Inner surface of bronchioles – Ciliated epithelium

17. (a) Glandular tissues are located in intestine and its major function is secretion.

18. (a)

Mast Cell

19. (d) Elastic cartilage is present in nose and ear.

20. (d) The squamous epithelium is made of a single thin layer of flattened cells with irregular boundaries. They are found in the walls of blood vessels and air sacs of lungs and are involved in functions like forming a diffusion boundary.

21. (c) If the columnar or cuboidal cells bear cilia on their free surface they are called ciliated epithelium. Their function is to move particles or mucus in a specific direction over the epithelium. They are mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes.

22. (b) Lining layer of fallopian tubes, nasal passages, bronchi and bronchioles consists of ciliated columnar epithelium

23. (a) Our pinna and nose tip is made up of yellow fibrous cartilage that provide support to these structures.

24. (d) All animal tissues have specialised junctions which providing structural and functional link between its individual cell. E.g., tight, adhering, gap junction. All three of them present in epithelium.

25. (d) In ciliated epithelium cells are interconnected via desmosomes and tight junctions, creating semipermeable membrane that is more selective than membrane found in other type of cells.

26. (a) Areolar tissue is a loose connective tissue. It functions mainly for binding the parts together but also helps in sliding movement of epithelia, muscles and other parts and also forms the internal histological frame work of many solid organs.

27. (b) Areolar tissue is a kind of loose connective tissue. It has cells and fibres loosely arranged in semi-fluid ground substance. Its main function is to binds with nervous and blood vessels.

28. (b) Epiphyses at the end of long bones are covered with articular cartilage also known as hyaline cartilage.

29. (c) Ligaments joins bone from another bone at the joint. Its absence may lead to improper articulation among bones and thus bone will become unfix.

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30. (b) The septal nasal cartilage is composed of hyaline cartilage.

31. (b) Simple epithelium is composed of a single layer of cells and functions as lining for body cavities, ducts and tubes.

32. (b) A ligament is a fibrous connective tissue that connect bones to other bones. These are bundles of dense regular connective tissue made up of collagenous fibres.

33. (d) Tendon is tough bond of fibrous connective tissue that usually connects muscle to bone. Tendons consists of dense regular connective tissue encased in dense irregular connective tissue.

34. (c) Chondrin is the protein present in cartilage. Cells of cartilage are embedded in a matrix of chondrin. Chondrin is a resilient translucent bluish-white substance.

35. (a) Basement membrane is a thin type of extracellular matrix, that provides support and aids in complex signaling. It is composed of two layers, the basal lamina and reticular lamina. It is made up of glycoproteins, collagen and lamina secreted by endothelial cell layer.

36. (a) It consists of a single layer of tall, simple columnar epithelial cells lying on a basement membrane.

37. (d) Compound stratified squamous epithelium covers moist surfaces where there is little wear and tear by friction such as inner lining of cheeks.

38. (a) Hair originates in the hair follicles. These follicles are located in the dermis which is the skin layer between the epidermis and fat layer.

39. (a) During bone formation, the cartilage cells die out & eaten up by chondroclasts; and these cartilage cells are replaced by osteoblasts clustered in ossification centres. Bone formation, in this way, proceeds outwards from these centres.

40. (a) Haversian canals are interconnected with one another via Volkmann's canals and contain a blood vessel, a nerve and a lymph vessel.

41. (a) Histamine is produced by basophils and by mast cells found in connective tissue. It increases the permeability of capillaries to WBCs & some proteins, to allow them to engage pathogens in infected tissues.

42. (b) Haemoglobin is red pigment found in blood of vertebrate. Its molecule comprises 4 subunits, each containing an iron atom (Fe) bound to a haem group.

43. (d) Long bones have extremities called epiphysis which is covered by hyaline cartilage or articular cartilage.

44. (c)
- Smooth muscles are uninucleate and involuntary.
- Skeletal muscle fibres are multinucleated and found in parallel bundles.
- Wall of blood vessels is lined by simple squamous epithelial tissue.

45. (b) The smooth muscle fibres taper at both ends (fusiform) and do not show striations. These are involuntary as their functioning cannot be directly controlled. These are present in the wall of internal organs such as the blood vessels, stomach and intestine. In cardiac muscle tissue, communication among the cells is performed by intercalated discs.

46. (d) The intercellular material of cartilage is solid and pliable and resists compression. Cells of this tissue (chondrocytes) are enclosed in small cavities within the matrix secreted by them

47. (c) Smooth muscles are 'involuntary' as their functioning cannot be directly controlled.

The smooth muscle fibres taper at both ends (fusiform) and do not show striations.

48. (a) Areolar tissue present beneath the skin.

Cuboidal epithelium found in ducts of glands and tubular parts of nephrons in kidneys.

The wall of internal organs such as the blood vessels, stomach and intestine contains smooth muscle tissue.

49. (b) Heat production is associated with respiration of skeletal muscle but not with skeletal system.

50. (a) The type of muscles present in our thighs are striated and voluntary (Skeletal muscle).

51. (b, d)

Heart → Involuntary, Striated muscle

Iris → Involuntary, Smooth

Biceps → Voluntary, Striated

Abdominal wall → Smooth, Involuntary

52. (c) Nerve cell consists of cell body (Perikaryon) containing the nucleus, Nissl granules, dendrites and an axon. These are specialised cells.

53. (c) Nerve cells are structurally separated functional units of nervous system. They do not form layers, instead neurons are stimulated and, electrical impulses are generated and travel from one neuron to another.

54. (a) The external opening of urethra is voluntarily controlled during urination. Thus, it contains voluntary or skeletal muscles.

55. (a) The smooth muscle consists of long, narrow unbranched spindle-shaped fibres. They are involuntary in action.

56. (c) Anal styles are paired, short, unjointed structure present only in male and help in sexual dimorphism.

57. (d) Insects like cockroach are uricotelic (excrete uric acid). In addition, the fat body, nephrocytes and urecose glands also help in excretion.

58. (b) Uricotelic only.

The cockroach is primarily uricotelic, excreting nitrogenous waste as uric acid.

59. (d) In cockroaches, the forewings are not transparent and are mesothoracic in origin. Forewings called tegmina are opaque dark and leathery and cover the hindwings when at rest. The hindwings are transparent, membranous and are used in flight.

60. (b)

A. Crop	- (IV) Storage of food
B. Proventriculus	- (I) Grinding the food particles
C. Hepatic caeca	- (II) Secretion of digestive juice
D. Malpighian tubules	- (III) Removal of nitrogenous waste

61. (a) Hepatic caeca

Hepatic caeca are involved in digestion rather than excretion in cockroaches. Malpighian tubules are the primary excretory organs in cockroaches. In addition, the fat body and urecose glands also help in excretion.

62. (c) Thorax of cockroach consists of three parts – prothorax, mesothorax and metathorax. The first pair of wings arises from mesothorax and the second pair from metathorax. Forewings of the cockroach are called tegmina. Tegmina are opaque dark and leathery and they cover hind wings when at rest.

63. (d) In cockroach, a ring of 6-8 blind tubules called hepatic or gastric caeca is present at the junction of foregut and midgut, which secrete digestive juice.

64. (b) The head of cockroach holds a bit of nervous system while the rest is situated along the ventral (belly-side) part of its body. So, if the head of the cockroach is cut off, it will still live for as long as one week.

65. (c) The mouth opens into a short tubular pharynx, leading to a narrow tubular passage called oesophagus. This in turn opens into a sac like structure called crop used for storing of food. The crop is followed by gizzard or proventriculus.

66. (d) Gizzard or proventriculus helps in grinding the food particles.

Hepatic caeca are present at the junction of foregut and midgut.

In both sexes of cockroach, the 10th segment bears a pair of jointed filamentous structures called anal cerci.

12 pairs of alary muscles are present in cockroach and are associated with heart and circulation of body.

The respiratory system consists of a network of trachea, that open through 10 pairs of small holes called spiracles present on the lateral side of the body.

67. (a) The correct sequence of organs in the alimentary canal of cockroach starting from mouth is :

Pharynx → Oesophagus → Crop → Gizzard → Ileum → Colon → Rectum

68. (b) In 9th sternum of abdomen of males, a pair of small, unjointed anal styles are present, also called caudal styles.

69. (c) The sperms are stored in the seminal vesicles and are glued together in the form of bundles called spermatophores which are discharged during copulation.

70. (b) Indeterminate and radial cleavage during embryonic development is not present in *Periplaneta americana* (cockroach).

71. (a) In each segment of *Periplaneta americana*, exoskeleton has hardened plates called sclerites (tergites dorsally and sternites ventrally) that are joined to each other by a thin and flexible articular membrane (Arthrodial membrane).

72. (a) Urate cells absorb nitrogenous waste products from haemolymph and synthesise uric acid from it for storage.

73. (b) Malpighian tubules are the main excretory structures in cockroach. They extract nitrogenous wastes and water from haemolymph and reabsorb certain salts resulting in precipitation of uric acid. So, cockroach is uricotelic. Males have paired anal styles on 9th abdominal sternite which are absent in females.

74. (d) Last nymphal stage has wing pads but only adult cockroach have wings.

75. (c) Male bear a pair of short, threadlike anal styles which are absent in females. In both sexes, the 10th segment bears a pair of jointed filamentous structures called anal cerci.

76. (a) Mandible and gizzard help in grinding of food in cockroach.

77. (d) Anal style is only present in male cockroach and absent in female cockroach.

78. (a) In cockroach, the compound eyes are situated at dorsal surface of the head and each eye consists of about 2000 hexagonal ommatidia. With the help of these ommatidia, a cockroach can receive several images of an object.

79. (a) Male cockroaches carry a pair of small, two-jointed anal styles in 9th sternum of abdomen and female cockroaches lack these.

80. (d) In male frog the sperms will move as follows:

Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca.

81. (d) Frog or the vertebrates have myogenic heart having self contractile system or are autoexcitable; because of this condition, it will keep on working outside the body for some time.

82. (d) In human beings, some mammals and amphibians (frog, toad etc.) excess of nitrogenous waste is urea and this mode is called ureotelic mode of excretion.

83. (c) The blood of frog is composed of plasma and cells. The blood cells are RBC (red blood cells) or erythrocytes, WBC (white blood cells) or leucocytes and platelets. RBC's are nucleated and contain red coloured pigment namely haemoglobin. The lymph is different from blood. It lacks few proteins and RBCs.

84. (c) Frogs respire on land and in the water by two different methods. In water, skin acts as aquatic respiratory organ (cutaneous respiration) On land, the buccal cavity, skin and lungs act as the respiratory organs.

Frog has three chambers, two atria and one ventricle and is covered by a membrane called pericardium. A triangular structure called sinus venous joins the right atrium.

85. (a) RBC's of frogs are nucleated and contain red coloured pigment namely haemoglobin.

Mature human RBCs lack a cell nucleus and most of the organelles.

86. (b) The ureters act as urinogenital duct in male frogs which open into the cloaca. The sperms are carried through the ureters.

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87. **(a)** When a bone is dropped in HCl, the calcium slowly starts to dissolve and the bone becomes brittle and more susceptible to breakage.

88. **(a)** Frontoparietal are flat bones that form the roof of the cranium. In this region, the frontal and parietal lobes meet.

89. **(b)** Hyoid apparatus provides surface for attachment of tongue muscles and thus indirectly helps in ingestion of food. It holds and support the pharynx & tongue from the skull. Movement of hyoid is critical in tongue protrusion of frogs.

90. **(c)** Fenestra ovalis is a small opening in a bone. In frogs, the middle ear is lined by air filled cavity, fenestra ovalis, to vestibule of inner ear.

91. **(d)** Mesonephros is one of three excretory organs that develop in vertebrates. It serves as main excretory organ of aquatic vertebrates and as a temporary kidney in reptiles, birds and mammals.

92. **(d)** When the frog is out of water mucus glands in the skin keep the frog moist, which helps them to absorb dissolved oxygen from the air.

93. **(c)** Stratum malpighii/stratum germinativum is the innermost layer of the skin consisting of one-celled thick columnar epithelial cells.

94. **(b)** Aquatic amphibians (tadpole) are ammonotelic, i.e., excrete ammonia whereas terrestrial amphibians (frog) excrete urea and are called ureotelic.

CHAPTER 8

Cell: The Unit of Life

An Overview of Cell and Cell Theory

1. The concept of "*Omnis cellula-e cellula*" regarding cell division was first proposed by *(2019)*
   a. Rudolf Virchow b. Theodor Schwann
   c. Schleiden d. Aristotle

2. Cellular organelles with membranes are: [MR*] *(2015 Re)*
   a. Chromosomes, ribosomes and endoplasmic reticulum
   b. Endoplasmic reticulum, ribosomes and nuclei
   c. Lysosomes, Golgi apparatus and mitochondria
   d. Nuclei, ribosome and mitochondria

3. Which of the following structures is not found in a prokaryotic cell? *(2015 Re)*
   a. Ribosome b. Mesosome
   c. Plasma membrane d. Nuclear envelope

4. Which of the following is not membrane-bound? *(2015 Re)*
   a. Ribosomes b. Lysosomes
   c. Mesosomes d. Vacuoles

5. Which one of the following organisms is not an example of eukaryotic cells? *(2011 Pre)*
   a. *Amoeba proteus* b. *Paramecium caudatum*
   c. *Escherichia coli* d. *Euglena viridis*

6. The main arena of various activities of a cell is *(2010 Pre)*
   a. Mitochondrion b. Cytoplasm
   c. Nucleus d. Plasma membrane

7. Membrane bound organelles are absent in: *(2010 Pre)*
   a. *Streptococcus* b. *Chlamydomonas*
   c. *Plasmodium* d. *Saccharomyces*

8. A major breakthrough in the studies of cells came with the development of electron microscope. This is because: [OS] *(2006)*
   a. Electron microscope is more powerful than the light microscope as it uses a beam of electrons which has wavelength much longer than that of photons
   b. Resolution power of electron microscope is much higher than that of light microscope
   c. Resolution power of electron microscope is 200-350 nm as compared to 0.1-0.2 nm for the light microscope
   d. Electron beam can pass through thick materials whereas light microscopy requires thin sections.

9. Which is correct about cell theory in view of current status of our knowledge about cell structure? *(1993)*
   a. It needs modification due to discovery of subcellular structures like chloroplasts and mitochondria
   b. Modified cell theory means that all living being are composed of cells capable of reproducing
   c. Cell theory does not hold good because all living beings (e.g., viruses) do not have cellular organisation
   d. Cell theory means that all living objects consists of cells whether or not capable of reproducing

10. Names of Schleiden and Schwann are associated with: *(1993)*
   a. Protoplasm as the physical basis of life
   b. Cell theory
   c. Theory of cell lineage
   d. Nucleus functions as control centre of cell

11. Resolution power is the ability to: [OS] *(1991)*
   a. Distinguish two close points
   b. Distinguish two close objects
   c. Distinguish amongst organelles
   d. Magnify image

12. Electron microscope has a high resolution power. This is due to: [OS] *(1992, 1990)*
   a. Electromagnetic lenses
   b. Very low wavelength of electron beam
   c. Low wavelength of light source used
   d. High numerical aperture of glass lenses used

13. Magnification of compound microscope is not connected with: [OS] *(1990)*
   a. Numerical aperture
   b. Focal length of objective
   c. Focal length of eye piece
   d. Tube length

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Prokaryotic Cells

14. Given below are two statements: *(2023-Manipur)*

Statement I: In bacteria, the mesosomes are formed by the extensions of plasma membrane.

Statement II: The mesosomes, in bacteria, help in DNA replication and cell wall formation.

In the light of the above statements, choose the **most appropriate** answer from the options given below:

a. **Statement I** is correct but **Statement II** is incorrect.
b. **Statement I** is incorrect but **Statement II** is correct.
c. Both **Statement I** and **Statement II** are correct.
d. Both **Statement I** and **Statement II** are incorrect.

15. Given below are two statements: *(2022)*

Statement I: Mycoplasma can pass through less than 1 micron filter size.

Statement II: Mycoplasma are bacteria with cell wall

In the light of the above statements, choose the most appropriate answer from the options given below.

a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both statement I and statement II are incorrect
d. Statement I is correct but Statement II is incorrect

16. Which of the following statements about inclusion bodies is incorrect? *(2020)*

a. These are involved in ingestion of food particles.
b. They lie free in the cytoplasm
c. These represent reserve material in cytoplasm
d. They are not bound by any membrane

17. Inclusion bodies of blue-green, purple and green photosynthetic bacteria are: *(2020-Covid)*

a. Gas vacuoles b. Centrioles
c. Microtubules d. Contractile vacuoles

18. The size of Pleuropneumonia - like Organism (PPLO) is: *(2020-Covid)*

a. 1 - 2 μm b. 10 - 20 μm
c. 0.1 μm d. 0.02 μm

19. Which among the following is not a prokaryote? *(2018)*

a. *Saccharomyces* b. *Mycobacterium*
c. *Nostoc* d. *Oscillatoria*

20. Many ribosomes may associate with a single mRNA to form multiple copies of a polypeptide simultaneously. Such strings of ribosomes are termed as *(2018)*

a. Polysome b. Polyhedral bodies
c. Plastidome d. Nucleosome

21. Which of the following components provides sticky character to the bacterial cell? **[OS]** *(2017-Delhi)*

a. Cell wall b. Nuclear membrane
c. Plasma membrane d. Glycocalyx

22. Select the wrong statement: *(2016 - I)*

a. Cyanobacteria lack flagellated cells.
b. Mycoplasma is a wall-less microorganism
c. Bacterial cell wall is made up of peptidoglycan.
d. Pili and fimbriae are mainly involved in motility of bacterial cells

23. Select the mismatch: *(2016 - I)*

a. Protists-Eukaryotes
b. Methanogens-Prokaryotes
c. Gas vacuoles-Green bacteria
d. Large central vacuoles-Animal cells

24. A complex of ribosomes attached to a single strand of RNA is known: *(2016 - I)*

a. Polysome b. Polymer
c. Polypeptide d. Okazaki fragment

25. Which one of the following is not an inclusion body found in prokaryotes? *(2013)*

a. Glycogen granule b. Polysome
c. Phosphate granule d. Cyanophycean granule

26. Chromatophores take part in: *(2015 Re*

a. Growth b. Movement
c. Respiration d. Photosynthesis

27. The structures that help some bacteria to attach to rocks and or host tissues are: *(2015 Re*

a. Fimbriae b. Mesosomes
c. Holdfast d. Rhizoids

28. The motile bacteria are able to move by: *(2014*

a. Pili b. Fimbriae
c. Flagella d. Cilia

29. Plant pathogenic bacteria are mostly: **[OS]** *(1999)*

a. Gram (+ve) + Non spore forming
b. Gram (–ve) + Non spore forming
c. Gram (+ve) + spore forming
d. Gram (–ve) + spore forming

30. The site of respiration in bacteria is: *(1997)*

a. Ribosome b. Microsome
c. Episome d. Mesosome

31. Angstrom (Å) is equal to: **[OS]** *(1992)*

a. 0.01 mm b. 0.001 mm
c. 0.0000001 mm d. 0.00001 mm

32. The main difference in Gram +ve and Gram –ve bacteria resides in their: *(1990)*

a. Cell wall b. Cell membrane
c. Cytoplasm d. Flagella

33. Organelles can be separated from cell homogenate through: **[OS]** *(1989)*

a. Chromatography b. X-rays diffraction
c. Differential centrifugation d. Auto-radiography

Cell Membrane and Cell Wall

34. Select the correct statement from the following regarding cell membrane: **[MR*]** *(2012 Pre)*

a. Fluid mosaic model of cell membrane was proposed by Singer and Nicolson
b. Na^+ and K^+ ions move across cell membrane by passive transport
c. Proteins make up 60 to 70% of the cell membrane
d. Lipids are arranged in a bilayer with polar heads towards the inner part

35. Which one of the following does not differ in *E.coli* and *Chlamydomonas*? *(2012 Pre)*

a. Cell membrane
b. Ribosomes
c. Chromosomal Organisation
d. Cell wall

36. Which one of the following structures between two adjacent cells is an effective transport pathway? *(2010 Pre)*

a. Plastoquinones b. Endoplasmic reticulum
c. Plasmalemma d. Plasmodesmata

37. The plasma membrane consists of: *(2010 Pre)*

a. Proteins embedded in a phospholipid bilayer
b. Protein embedded in a polymer of glucose molecules
c. Proteins embedded in a carbohydrate bilayer
d. Phospholipids embedded in a protein bilayer.

38. Middle lamella is mainly composed of: *(2009)*

a. Hemicellulose b. Calcium pectate
c. Muramic acid d. Phosphoglycerides

39. Plasmodesmata are: *(2009)*

a. Locomotory structures
b. Lignified cement between cells
c. Connection between adjacent cells
d. Membranes connecting nucleus and plasmalemma

40. Which is correct in view of fluid mosaic model? *(2008)*

a. Proteins can flip-flop, lipids cannot
b. Neither proteins nor lipids can flip-flop
c. Both lipids and proteins can flip-flop
d. Lipids can rarely flip-flop, proteins cannot

41. Which is not constituent of cell membrane? *(2007)*

a. Glycolipids b. Phospholipids
c. Cholesterol d. Proline

42. As per fluid mosaic model, lipids and integral proteins can diffuse randomly. The model has been modified in several aspects. Which of the following statements is incorrect? *(2005)*

a. Protein of cell membrane can travel within lipid bilayer
b. Protein of cell membrane can undergo flip-flop movement in lipid bilayer
c. Protein can remain confined within certain domains of the membrane.
d. Many proteins remain completely embedded within lipid bilayer

43. In fluid mosaic model of plasma membrane: *(2002)*

a. Upper layer is non-polar and hydrophilic
b. Polar layer is hydrophobic
c. Phospholipids form a bimolecular layer in middle part
d. Proteins form a middle layer

44. Difference in Gram +ve and Gram -ve bacteria is due to: *(2001)*

a. Cell wall b. Cell membrane
c. Ribosome d. Cytoplasm

45. Difference between eukaryotes and prokaryotes: *(1998)*

a. ss circular DNA in prokaryotes
b. Histone with prokaryotic DNA
c. Operon in eukaryotes
d. Membrane bound organelles in eukaryotes

46. The desmosomes are concerned with: **[OS]** *(1995)*

a. Cell division b. Cell adherence
c. Cytolysis d. Cellular excretion

47. Active and passive transports across cell membrane differ in: *(1993)*

a. Passive transport is non-selective
b. Passive transport is along the concentration gradient while active transport is due to metabolic energy
c. Active transport is more rapid
d. Passive transport is confined to anions while active transport in confined to cations

48. Cell recognition and adhesion occur due to biochemicals of cell membranes named: *(1993)*

a. Proteins b. Lipids
c. Proteins and lipids d. Glycoproteins and glycolipids

49. Addition of new cell wall particles amongst the existing ones is: **[OS]** *(1991)*

a. Deposition b. Apposition
c. Intussusception d. Aggregation

50. Cell wall shows: *(1991)*

a. Complete permeability
b. Semipermeability
c. Differential permeability
d. Impermeability

51. Fluid mosaic model of cell membrane was put forward by: *(1991)*

a. Danielli and Davson b. Singer and Nicolson
c. Garner and Allard d. Watson and Crick

52. The latest model for plasma membrane is: *(1990)*

a. Lamellar model b. Unit membrane model
c. Fluid mosaic model d. Molecular lipid model

53. Plasma membrane is made of: *(1989)*

a. Proteins and carbohydrates
b. Proteins and lipids
c. Proteins, lipids and carbohydrates
d. Proteins, some nucleic acid and lipids

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54. According to fluid mosaic model, plasma membrane is composed of: *(1988)*
a. Phospholipids and oligosaccharides
b. Phospholipids and hemicellulose
c. Phospholipids and integral proteins
d. Phospholipids, extrinsic proteins and intrinsic proteins

Endomembrane System

55. Which of the following are NOT considered as the part of endomembrane system? [MR*] *(2023)*
A. Mitochondria B. Endoplasmic Reticulum
C. Chloroplasts E. Peroxisomes
D. Golgi complex
Choose the most appropriate answer from the options given below:
a. A, D and E only b. B and D only
c. A, C and E only d. A and D only

56. Which of the following statements are **correct** with respect of Golgi apparatus? *(2023-Manipur)*
A. It is the important site of formation of glycoprotein and glycolipids.
B. It produces cellular energy in the form of ATP.
C. It modifies the protein synthesized by ribosomes on ER.
D. It facilitates the transport of ions.
E. It provides mechanical support.
Choose the **most appropriate** answer from the options given below:
a. (B) and (C) only b. (A) and (C) only
c. (A) and (D) only d. (D) and (E) only

57. If the pH in lysosomes is increased to alkaline, what will be the outcome? *(2022 Re)*
a. Lysosomal enzymes will be more active
b. Hydrolytic enzymes will function more efficiently
c. Hydrolytic enzymes will become inactive
d. Lysosomal enzymes will be released into the cytoplasm

58. The organelles that are included in the endomembrane system are: *(2021)*
a. Endoplasmic reticulum, Golgi complex, Lysosomes and Vacuoles.
b. Golgi complex, Mitochondria, Ribosomes and Lysosomes.
c. Golgi complex, Endoplasmic reticulum, Mitochondria and Lysosomes.
d. Endoplasmic reticulum, Mitochondria, Ribosomes and Lysosomes.

59. Which is the important site of formation of glycoproteins and glycolipids in eukaryotic cells? *(2020)*
a. Peroxisomes b. Golgi bodies
c. Polysomes d. Endoplasmic reticulum

60. Which of the following statements is **not** correct? [MR*] *(2019)*
a. Lysosomes have numerous hydrolytic enzymes.
b. The hydrolytic enzymes of lysosomes are active under acidic pH.
c. Lysosomes are membrane bound structures.
d. Lysosomes are formed by the process of packaging in the endoplasmic reticulum.

61. The Golgi complex participates in *(2018)*
a. Fatty acid breakdown
b. Formation of secretory vesicles
c. Respiration in bacteria
d. Activation of amino acid

62. Which of the following events does not occur in rough endoplasmic reticulum? *(2018)*
a. Protein folding b. Protein glycosylation
c. Cleavage of signal peptide d. Phospholipid synthesis

63. A cell organelle containing hydrolytic enzymes is: *(2016 - II)*
a. Ribosome b. Mesosome
c. Lysosome d. Microsome

64. Select the correct matching in the following pairs: *(2015)*
a. Rough ER – Synthesis of glycogen
b. Rough ER – Oxidation of fatty acids
c. Smooth ER – Oxidation of phospholipids
d. Smooth ER – Synthesis of lipids

65. The osmotic expansion of a cell kept in water is chiefly regulated by: *(2014)*
a. Ribosomes b. Mitochondria
c. Vacuoles d. Plastids

66. Which one of the following organelle in the figure correctly matches with its function? *(2013)*

a. Rough endoplasmic reticulum, protein synthesis
b. Rough endoplasmic reticulum, formation of glycoproteins
c. Golgi apparatus, protein synthesis
d. Golgi apparatus, formation of glycolipids

67. A major site for synthesis of lipids is: *(2013)*
a. Nucleoplasm b. RER
c. SER d. Symplast

68. The Golgi complex plays a major role: *(2013)*
a. In post translational modification of proteins and glycosidation of lipids
b. In trapping the light and transforming it into chemical energy
c. In digesting proteins and carbohydrates
d. As energy transferring organelles

69. Which one of the following is not considered as a part of the endomembrane system? *(2011 Mains)*
a. Vacuole b. Lysosome
c. Golgi complex d. Peroxisome

70. Important site for formation of glycoproteins and glycolipids is: *(2011 Pre)*
a. Lysosome b. Vacuole
c. Golgi apparatus d. Plastid

71. In plant cell, the vacuole: *(2008)*
a. Contains air and lacks membrane
b. Contains water and excretory substances but lacks membrane
c. Contains storage protein and lipids and is membrane bound
d. Is membrane bound, contains water and excretory substances

72. Organelle involved in modification and routing of newly synthesized proteins to their destination is: *(2005)*
a. Chloroplast b. Lysosome
c. Mitochondrion d. Endoplasmic reticulum

73. Protein synthesis in an animal cell occurs: *(2005)*
a. On cytosolic ribosomes only
b. On ribosomes attached to E.R. and nuclear envelope
c. On ribosomes present in nucleolus as well as cytoplasm
d. On ribosomes present both in cytoplasm as well as mitochondria

74. In protozoa like *Amoeba* and *Paramoecium*, an organ is found for osmoregulation which is: *(2002)*
a. Contractile vacuole b. Mitochondria
c. Nucleus d. Food vacuole

75. Which cell organelle is concerned with glycosylation of protein? *(2000)*
a. Ribosome b. Peroxisome
c. Endoplasmic reticulum d. Mitochondria

76. Lysosome contains: *(2000)*
a. Oxidative enzymes b. Hydrolytic enzymes
c. Reductive enzymes d. Anabolic enzymes

77. Protein synthesis in an animal cell takes place: *(1997)*
a. In the cytoplasm as well as in the endoplasmic reticulum
b. Only on ribose attached to nucleon
c. Only in the cytoplasm
d. In the nucleolus as well as in the cytoplasm

78. Lysosomes are rich in: *(1996)*
a. Nucleic acids b. Hydrolytic enzymes
c. Carbohydrates d. Hormones

79. Which of the following organelles contain enzymes that have digestive action? *(1994)*
a. Ribosomes b. Polysomes
c. Plastids d. Lysosomes

80. Which one of the following organelles is located near the nucleus and contains a collection of flattened membrane bound cisternae? *(1994)*
a. Nucleolus b. Mitochondrion
c. Centriole d. Golgi apparatus

81. Besides giving out secretory vesicles, the Golgi apparatus is also concerned with the formation of: *(1994)*
a. Lysosomes
b. Plastids
c. Grana of chloroplasts
d. Cell plates after cell division in plants

82. In plant cells, peroxisomes are associated with: [OS] *(1993)*
a. Photorespiration b. Phototropism
c. Photoperiodism d. Photosynthesis

83. Membranous bag with hydrolytic enzymes which is used for controlling intracellular digestion of macro-molecules is: *(1993)*
a. Endoplasmic reticulum b. Nucleosome
c. Lysosome d. Phagosome

84. Golgi apparatus is absent in: *(1993)*
a. Higher plants
b. Yeast
c. Bacteria and Blue-green algae
d. None

85. Which one is *apparato reticolare*? [OS] *(1992)*
a. Golgi apparatus b. Endoplasmic reticulum
c. Microfilaments d. Microtubules

86. In *Amoeba* and *Paramoecium* osmoregulation occurs through: *(1991)*
a. Pseudopodia b. Nucleus
c. Contractile vacuole d. General surface

Mitochondria, Plastids, Ribosomes

87. Which of the following pair of organelles does **not** contain DNA? *(2019)*
a. Mitochondria and Lysosomes
b. Chloroplast and Vacuoles
c. Lysosomes and Vacuoles
d. Nuclear envelope and Mitochondria

88. Which of the following statements regarding mitochondria is incorrect? [OS] *(2019)*
a. Outer membrane is permeable to monomers of carbohydrates, fats and proteins.
b. Enzymes of electron transport are embedded in outer membrane.
c. Inner membrane is convoluted with infoldings.
d. Mitochondrial matrix contains single circular DNA molecule and ribosomes.

89. Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP? *(2017-Delhi)*
a. Lysosome b. Ribosome
c. Chloroplast d. Mitochondrion

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90. Mitochondria and chloroplast are
A. Semi-autonomous organelles
B. Formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery
Which one of the following options is correct? *(2016-I)*
a. Both (A) and (B) are correct
b. (B) is true but (A) is false
c. (A) is true but (B) is false
d. Both (A) and (B) are false

91. The structures that are formed by stacking of organized flattened membranous sacs in the chloroplasts are: *(2015)*
a. Stroma lamellae b. Stroma
c. Cristae d. Grana

92. DNA is not present in: *(2015)*
a. Nucleus b. Mitochondria
c. Chloroplast d. Ribosomes

93. Which structures perform the function of mitochondria in bacteria? *(2014)*
a. Mesosomes b. Nucleoid
c. Ribosomes d. Cell wall

94. Which one of the following cellular parts is correctly described? *(2012 Mains)*
a. Thylakoids-flattened membranous sacs forming the grana of chloroplasts
b. Centrioles-sites for active RNA synthesis
c. Ribosomes-those on chloroplasts are larger (80S) while those in the cytoplasm are smaller (70S)
d. Lysosomes-optimally active at a pH of about 8.5

95. Which one of the following structures is an organelle within an organelle? *(2012 Mains)*
a. Ribosome b. Peroxisome
c. ER d. Mesosome

96. What is true about ribosomes? *(2012 Pre)*
a. These are self-splicing introns of some RNAs
b. The prokaryotic ribosomes are 80S, where "S" stands for sedimentation coefficient
c. These are composed of ribonucleic acid and proteins
d. These are found only in eukaryotic cells

97. The figure below shows the structure of a mitochondrion with its four parts labeled (A), (B), (C) and (D). Select the part correctly matched with its function. *(2011 Mains)*

a. Part (C): Cristae – possess single circular DNA molecule and ribosomes
b. Part (A): Matrix – major site for respiratory chain enzymes
c. Part (D): Outer membrane – gives rise to inner membrane by splitting
d. Part (B): Inner membrane – forms infoldings called cristae

98. Peptide synthesis inside a cell takes place in: *(201)*
a. Ribosomes b. Chloroplast
c. Mitochondria d. Chromoplast

99. In land plants the guard cells differ from other epide... cells in having: *(201)*
a. Chloroplasts b. Cytoskeleton
c. Mitochondria d. Endoplasmic reticulum

100. Which is wrong?
a. Both chloroplast and mitochondrion have an ... compartment of thylakoid space bounded by thyl... membrane
b. Both contain DNA
c. Chloroplast is generally larger
d. Both are covered by double membrane

101. Which of the following statement regarding mitocho... membrane is not correct?
a. Outer membrane resembles a sieve
b. Outer membrane is permeable to all kinds of mole...
c. Enzymes of electron transport chain are embedd... outer membrane
d. Inner membrane is highly convoluted forming a ser... infoldings.

102. In chloroplasts the chlorophyll is located in:
a. Stroma b. Grana
c. Pyrenoid d. Both (a) and (b)

103. Extranuclear inheritance is a consequence of presen... genes in: [OS]
a. Endoplasmic reticulum and mitochondria
b. Ribosomes and chloroplast
c. Lysosomes and ribosomes
d. Mitochondria and chloroplasts

104. In chloroplasts, chlorophyll is present in the:
a. Inner membrane b. Thylakoids
c. Stroma d. Outer membrane

105. What used to be described as Nissl granules in a neur... are now identified as:
a. Cell metabolites b. Fat granules
c. Ribosomes d. Mitochondria

106. The cells of the quiescent centre are characterised by: [OS]
a. Having dense cytoplasm and prominent nuclei
b. Having light cytoplasm and small nuclei
c. Dividing regularly to add to the corpus
d. Dividing regularly to add to tunica

107. Which of the following ribosomes are engaged in pro... synthesis in animal cell?
a. Ribosomes which occur on nuclear membrane and E...
b. Ribosomes of only cytosol
c. Ribosomes of only nucleolus and cytosol
d. Ribosomes of only mitochondria and cytosol

108. Extranuclear DNA is found in: [OS] *(2000)*
a. Lysosome and chloroplast
b. Chloroplast and mitochondria
c. Mitochondria and lysosome
d. Golgi and E.R.

109. What change occurs during conversion of proto chlorophyll to chlorophyll? [OS] *(1998)*
a. Addition of $2H^+$ in one pyrrole ring
b. Loss of $2H^+$
c. Addition of Mg
d. Loss of Mg

110. In mitochondria, cristae act as sites for: *(1994)*
a. Protein synthesis
b. Phosphorylation of flavoproteins
c. Breakdown of macromolecules
d. Oxidation-reduction reaction

111. The inner membrane of the mitochondria is, usually, highly convoluted forming a series of infoldings known as: *(1994)*
a. Thylakoids b. Lamellae
c. Cristae d. Grana

112. All types of plastids possess essentially the same structure because they: [OS] *(1992)*
a. Perform the same function
b. Store food materials like starch, fat and protein
c. Occur in aerial parts
d. Can transform from one form to another

113. Oxysomes of F_0 - F_1 particles occur on: *(1992)*
a. Thylakoids
b. Mitochondrial surface
c. Inner mitochondrial membrane
d. Chloroplast surface

114. Ribosomes are the centre for: *(1992)*
a. Respiration b. Photosynthesis
c. Protein synthesis d. Fat synthesis

115. Ribosomes were discovered by: *(1991)*
a. Golgi b. Porter
c. De Robertis d. Palade

116. Polyribosomes are aggregates of: *(1989)*
a. Ribosomes and rRNA
b. Only rRNA
c. Peroxisomes
d. Several ribosomes held together by string of *m*RNA

Cytoskeleton, Cilia and Flagella, Centrosome and Centrioles

117. Which of the following functions is carried out by cytoskeleton in a cell? *(2023)*
a. Transportation b. Nuclear division
c. Protein synthesis d. Motility

118. Match the following columns and select the correct option: [MR*] *(2020-Covid)*

	Column-I		Column-II
A.	Smooth Endoplasmic Reticulum	i.	Protein synthesis
B.	Rough endoplasmic reticulum	ii.	Lipid synthesis
C.	Golgi complex	iii.	Glycosylation
D.	Centriole	iv.	Spindle formation

	A	B	C	D
a.	(iii)	(i)	(ii)	(iv)
b.	(iv)	(ii)	(i)	(iii)
c.	(i)	(ii)	(iii)	(iv)
d.	(ii)	(i)	(iii)	(iv)

119. Microtubules are the constituents of: *(2016-I)*
a. Cilia, Flagella and Peroxisomes
b. Spindle fibres, Centrioles and Cilia
c. Centrioles, Spindle fibres and Chromatin
d. Centrosome, Nucleosome and Centrioles

120. The solid linear cytoskeleton elements having a diameter of 6 nm and made up of a single type of monomer are known as: [OS] *(2014)*
a. Lamins b. Microtubules
c. Microfilaments d. Intermediate filaments

121. Match the following and select the correct answer: [MR*] *(2014)*

A.	Centriole	i.	Infoldings in mitochondria
B.	Chlorophyll	ii.	Thylakoids
C.	Cristae	iii.	Nucleic acids
D.	Ribozymes	iv.	Basal body cilia or flagella

a. A-iv B-iii C-i D-ii
b. A-iv B-ii C-i D-iii
c. A-i B-ii C-iv D-iii
d. A-i B-iii C-ii D-iv

122. An elaborate network of filamentous proteinaceous structures which helps in the maintenance of cell shape is called: *(2010 Mains)*
a. Plasmalemma b. Cytoskeleton
c. Endoplasmic reticulum d. Thylakoids

123. Cytoskeleton is formed of:
a. Callose deposits
b. Cellulose microfibrils
c. Calcium carbonate granules
d. Proteinaceous filaments

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124. Which of the following statements about cilia is not correct? *(2006)*
a. Organised beating of cilia is controlled by fluxes of Ca^{2+} across the membrane
b. Cilia are hair like cellular appendages
c. Cilia contain an outer ring of nine doublet microtubules surrounding two singlet microtubules
d. Microtubules of cilia are composed of tubulin.

125. Flagella of prokaryotic and eukaryotic cells differ in: *(2004)*
a. Location in cell and mode of functioning
b. Microtubular organisation and type of movement
c. Microtubular organisation and function
d. Type of movement & placement in cell

126. Microtubules absent in: *(2001)*
a. Mitochondria b. Flagella
c. Spindle fibers d. Centriole

127. Double unit membrane is absent in: *(1999)*
a. Ribosomes b. Nucleus
c. Plastids d. E.R.

128. Role of microtubules: *(1998)*
a. To help in cell division b. Cell membrane formation
c. Respiration d. Pinocytosis

129. Which of the following structures will not be common to mitotic cell of a higher plant? *(1997)*
a. Centriole b. Spindle
c. Cell plate d. Centromere

130. The prokaryotic flagella possess: *(1995)*
a. Helically arranged protein molecule
b. "9 + 2" membrane enclosed structure
c. Unit membrane enclosed fibre
d. Protein membrane enclosed fibre

131. Centromere is required for: *(1994)*
a. Replication of DNA
b. Chromosome segregation
c. Poleward movement of chromosomes
d. Cytoplasmic cleavage

Nucleus and Microbodies

132. Match List-I with List-II. [MR*] *(2022)*

List-I		List-II	
A.	Metacentric chromosome	i.	Centromere situated close to the end forming one extremely short and one very long arms
B.	Acrocentric chromosome	ii.	Centromere at the terminal end
C.	Sub-metacentric	iii.	Centromere in the middle forming two equal arms of chromosomes
D.	Telocentric chromosome	iv.	Centromere slightly away from the middle forming one shorter arm and one longer arm

Choose the correct answer from the options given below.
a. A-i B-ii C-iii D-iv
b. A-iii B-i C-iv D-ii
c. A-i B-iii C-ii D-iv
d. A-ii B-iii C-iv D-i

133. Which of the following is an incorrect statement? [MR*] *(2021)*
a. Microbodies are present both in plant and animal cells.
b. The perinuclear space forms a barrier between the material present inside the nucleus and that of the cytoplasm.
c. Nuclear pores act as passages for proteins and RNA molecules in both directions between nucleus and cytoplasm.
d. Mature sieve tube elements possess a conspicuous nucleus and usual cytoplasmic organelles.

134. Match List-1 with List-2 [MR*] *(2021)*

List-1		List-2	
A.	Cristae	i.	Primary constriction in chromosome
B.	Thylakoids	ii.	Disc-shaped sacs in Golgi apparatus
C.	Centromere	iii.	Infoldings in mitochondria
D.	Cisternae	iv.	Flattened membranous sacs in stroma of plastids

Choose the correct answer from the options given below.
a. A-i B-iv C-iii D-ii
b. A-iii B-iv C-i D-ii
c. A-ii B-iii C-iv D-i
d. A-iv B-iii C-ii D-i

135. When the centromere is situated in the middle of two equal arms of chromosomes, the chromosome is referred as *(2021)*
a. Telocentric b. Sub-metacentric
c. Acrocentric d. Metacentric

136. The biosynthesis of ribosomal RNA occurs in: *(2020-Covid)*
a. Golgi apparatus b. Microbodies
c. Nucleolus d. Ribosomes

137. The shorter and longer arms of a submetacentric chromosome are referred to as [OS] *(2019)*
a. s-arm and l-arm respectively
b. p-arm and q-arm respectively
c. q-arm and p-arm respectively
d. m-arm and n-arm respectively

138. Which of the following is true for nucleolus? *(2018)*
a. Larger nucleoli are present in dividing cells.
b. It is a membrane-bound structure.
c. It takes part in spindle formation.
d. It is a site for active ribosomal RNA synthesis

139. The chromosomes in which centromere are situated close to one end are: *(2015)*
a. Telocentric b. Sub-metacentric
c. Metacentric d. Acrocentric

140. Nuclear envelope is a derivative of: *(2015)*
a. Microtubules
b. Rough endoplasmic reticulum
c. Smooth endoplasmic reticulum
d. Membrane of Golgi complex

141. Balbiani rings are sites of: [OS] *(2015 Re)*
a. Nucleotide synthesis
b. Polysaccharide synthesis
c. RNA and protein synthesis
d. Lipid synthesis

142. Match the columns and identify the correct option. *(2015 Re)*

Column-I		Column-II	
A.	Thylakoids	i.	Disc-shaped sacs in Golgi apparatus
B.	Cristae	ii.	Condensed structure of DNA
C.	Cisternae	iii.	Flat membranous sacs in stroma
D.	Chromatin	iv.	Infoldings in mitochondria

a. A-(iii), B-(iv), C-(i), D-(ii)
b. A-(iii), B-(i), C-(iv), D-(ii)
c. A-(iii), B-(iv), C-(ii), D-(i)
d. A-(iv), B-(iii), C-(i), D-(ii)

143. Ribosomal RNA is actively synthesised in: *(2012 Pre)*
a. Ribosomes b. Lysosomes
c. Nucleolus d. Nucleoplasm

144. DNA is absent in: [OS] *(2009)*
a. Mature spermatozoan b. Mature RBC
c. Hair root d. Enucleated ovum

145. Which of the following occurs more than one and less than five in a chromosome? *(2002)*
a. Chromatid b. Chromomere
c. Centromere d. Telomere

146. Ribosomes are produced in: *(2002)*
a. Nucleolus b. Cytoplasm
c. Mitochondria d. Golgi body

147. Extranuclear chromosomes occur in: [OS] *(2001)*
a. Peroxisome and Ribosome
b. Chloroplast and Mitochondria
c. Mitochondria and Ribosome
d. Chloroplast and Lysosome

148. Function of telomeres in nucleus: *(2000)*
a. Poleward movement
b. To initiate the RNA synthesis
c. To seal the ends of chromosome
d. To recognise the homologous chromosome

149. Each chromosome at the anaphase stage of a bone marrow cell in our body has: *(1995)*
a. Two chromatids b. Several chromatids
c. No chromatids d. Only one chromatid

150. The polytene chromosomes were discovered for the first time in: *(1995)*
a. *Drosophila* b. *Musca domestica*
c. *Chironomus* d. *Musca nebula*

151. The point, at which polytene chromosomes appear to be attached together, is called: *(1995)*
a. Centromere b. Chromomere
c. Chromocentre d. Centriole

152. Balbiani rings (puffs) are sites of: [OS] *(1993)*
a. DNA replication
b. RNA and protein synthesis
c. Synthesis of polysaccharides
d. Synthesis of lipids

153. Binding of specific protein on regulatory DNA sequences can be studied by means of: *(1993)*
a. Ultra centrifugation b. Electron microscope
c. Light microscope d. X-rays crystallography

154. In salivary gland chromosomes/polytene chromosomes, pairing is: [OS] *(1993)*
a. Absent
b. Occasional
c. Formed between non-homologous chromosomes
d. Formed between homologous chromosomes

155. Experiments on *Acetabularia* by Hammerling proved th5 role of: [OS] *(1992)*
a. Cytoplasm in controlling differentiation
b. Nucleus in heredity
c. Chromosomes in heredity
d. Nucleo-cytoplasmic ratio

156. Which is distributed more widely in a cell? *(1992)*
a. DNA b. RNA
c. Chloroplasts d. Sphaerosomes

157. An outer covering membrane is absent over: *(1992)*
a. Nucleolus b. Lysosome
c. Mitochondrion d. Plastid

158. Hammerling's experiments of *Acetabularia* involved exchanging: [OS] *(1990)*
a. Cytoplasm b. Nucleus
c. Rhizoid and stalk d. Gametes

159. Nucleoproteins are synthesised in: *(1989)*
a. Nucleoplasm b. Nuclear envelope
c. Nucleolus d. Cytoplasm

160. *Acetabularia* used in Hammerling's nucleocytoplasmic experiments is: [OS] *(1988)*
a. Unicellular fungus
b. Multicellular fungus
c. Unicellular uninucleate green algae
d. Unicellular multinucleate green algae

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Answer Key

1. (a)	2. (c)	3. (d)	4. (a)	5. (c)	6. (b)	7. (a)	8. (b)	9. (c)	10. (b)
11. (a)	12. (b)	13. (a)	14. (c)	15. (d)	16. (a)	17. (a)	18. (c)	19. (a)	20. (a)
21. (d)	22. (d)	23. (d)	24. (a)	25. (b)	26. (d)	27. (a)	28. (c)	29. (d)	30. (d)
31. (c)	32. (a)	33. (c)	34. (a)	35. (a)	36. (d)	37. (a)	38. (b)	39. (c)	40. (d)
41. (d)	42. (b)	43. (c)	44. (a)	45. (d)	46. (b)	47. (b)	48. (d)	49. (c)	50. (a)
51. (b)	52. (c)	53. (c)	54. (d)	55. (c)	56. (b)	57. (c)	58. (a)	59. (b)	60. (d)
61. (b)	62. (d)	63. (c)	64. (d)	65. (c)	66. (a)	67. (c)	68. (a)	69. (d)	70. (c)
71. (d)	72. (d)	73. (d)	74. (a)	75. (c)	76. (b)	77. (a)	78. (b)	79. (d)	80. (d)
81. (a)	82. (a)	83. (c)	84. (c)	85. (a)	86. (c)	87. (c)	88. (b)	89. (d)	90. (c)
91. (d)	92. (d)	93. (a)	94. (a)	95. (a)	96. (c)	97. (d)	98. (a)	99. (a)	100. (a)
101. (c)	102. (b)	103. (d)	104. (b)	105. (c)	106. (b)	107. (a)	108. (b)	109. (a)	110. (d)
111. (c)	112. (d)	113. (c)	114. (c)	115. (d)	116. (d)	117. (d)	118. (d)	119. (b)	120. (c)
121. (b)	122. (b)	123. (d)	124. (a)	125. (b)	126. (a)	127. (a)	128. (a)	129. (a)	130. (a)
131. (c)	132. (b)	133. (d)	134. (b)	135. (d)	136. (c)	137. (b)	138. (d)	139. (d)	140. (b)
141. (c)	142. (a)	143. (c)	144. (b)	145. (d)	146. (a)	147. (b)	148. (c)	149. (d)	150. (c)
			154. (d)	155. (b)	156. (b)	157. (a)	158. (c)	159. (d)	160. (c)

Explanations

e cellula" regarding cell theory was first proposed by Rudolf Virchow.

2. **(c)** Ribosomes are the granular structures first observed by George Palade (1953). They are not surrounded by any membrane.

3. **(d)** Prokaryotic cells do not have membrane bound organelles. They lack a membrane bound nucleus.

4. **(a)** Ribosome's are the granular structures mainly composed of RNA and proteins. They are not surrounded by any membrane.

5. **(c)** *E. coli* is a prokaryotic bacterium.

6. **(b)** The cytoplasm is the main area of cellular activities in both plants and animals

7. **(a)** Prokaryotes do not have membrane bound organelle. *Chlamydomonas* (Algae), *Plasmodium* (Protozoa), *Saccharomyces* (Fungi) are eukaryotes bearing cell organelle.

8. **(b)** Resolution power of electron microscope is much higher than that of light microscope.

9. **(c)** Viruses are living but they do not have structure of a particular cell, they become living after infecting the host cell. However, according to cell theory, "all living organisms are composed of cells & products of cells". Here, cell theory does not hold good.

10. **(b)** Schwann & Schleiden together formulated the cell theory.

11. **(a)** Resolution power is the ability to distinguish two close points.

12. **(b)** Electron microscope has a high resolution power. This is due to very low wavelength of electron beam (0.005 mu) of the electron beam which is used as light source. It is produced when a metal filament is heated in a vacuum tube at high temperature, i.e., 50,000 volts.

13. **(a)** Numerical aperture is a measure of how much light can be collected by a microscope lens. It has no relation with magnification of compound microscope.

14. **(c)** Both Statement I and Statement II are correct.

Mesosomes in bacteria, formed by the invagination of the plasma membrane that play roles in DNA replication, distribution of chromosomes to daughter cells, and cell wall formation during cell division.

15. **(d)** Mycoplasma are the smallest bacteria. They lack a cell wall and can survive without oxygen. They can cause diseases in plants and animals. Their small size allows them to pass through 0.1 µm sterilizing filters.

16. **(a)** Reserve material in prokaryotic cells are stored in the cytoplasm in the form of inclusion bodies. These are not bound by any membrane system and lie free in the cytoplasm.

Lysosomes are involved in ingestion of food particle.

17. **(a)** Reserve material in prokaryotic cells are stored in the cytoplasm in the form of inclusion bodies. These are not bound by any membrane system and lie free in the cytoplasm, e.g., phosphate granules, cyanophycean granules and glycogen granules. Gas vacuoles are found in blue green and purple and green photosynthetic bacteria.

18. **(c)** The prokaryotic cells are represented by bacteria, blue-green algae, mycoplasma and PPLO (Pleuro Pneumonia Like Organisms). The size of PPLO is 0.1 µm.

19. **(a)** *Saccharomyces* is a genus of yeast.

20. **(a)** Polysome or polyribosome is a cluster of ribosomes held together by a strand of mRNA.

21. **(d)** Sticky character of the bacterial wall is due to glycocalyx or slime layer. This layer is rich in glycoproteins.

22. **(d)** The pili are elongated tubular structures made of a special protein. The fimbriae are small bristle like fibres sprouting out of the cell. In some bacteria, they are known to help attach the bacteria to rocks in streams and also to the host tissues but they do not play a role in motility.

23. **(d)** Plant and animal cells are different as plant cells possess cell walls, plastids and a large central vacuole which are absent in animal cells. On the other hand, animal cells have centrioles which are absent in almost all plant cells.

24. **(a)** Ribosomes are the site of protein synthesis. Several ribosomes may attach to a single mRNA and form a chain called polyribosomes or polysome.

25. **(b)** Reserve material in prokaryotic cells are stored in the cytoplasm in the form of inclusion bodies, e.g., phosphate granules, glycogen granules and cyanophycean granules.

26. **(d)** In some prokaryotes like cyanobacteria, there are other membranous extensions besides mesosomes, into the cytoplasm called chromatophores which contain photosynthetic pigments.

27. **(a)** The fimbriae are small bristle like fibers sprouting out of the cell. They are known to help in attachment of the bacteria to rocks in streams and also to the host tissues.

28. **(c)** Flagella aids motility. While pili and fimbriae do not play a role in motility.

29. **(d)** Most of the phytopathogenic (plant pathogen) bacteria have thin cell wall & do not accept the Gram stain, thus, they are Gram -ve and form spores.

30. **(d)** Mesosome is an organelle of bacteria that appears as an invagination of plasma membrane and is a site of localisation of respiratory enzymes. They are clumped & folded together to maximise their surface area, needed for cell respiration.

31. **(c)** An Angstrom is equal to 10^{-10} = 10 nm
One nanometer (nm) has the value $10^{-9} = 10^{-6}$ mm
$\therefore 1Å = 10^{-7}$mm

32. **(a)** Gram -ve bacteria show Gram staining due to thick layer of peptidoglycan in cell wall. In Gram -ve bacteria, this layer is thin & surrounded by an outer membrane, hence, they are negative towards Gram staining.

33. **(c)** Differential centrifugation is a common procedure in microbiology and cytology used to separate certain organelles from whole cells for further analysis of specific parts of the cells.

34. **(a)** The detailed structure of the membrane was studied only after the advent of the electron microscope in the 1950s. An improved model of the structure of cell membrane was proposed by Singer and Nicolson (1972) widely accepted as fluid mosaic model.

35. **(a)** Cell membrane of prokaryotes is structurally similar to that of eukaryotes. So, it does not differ in *E.coli* and *Chlamydomonas*.

36. **(d)** In plant cell, the cell wall and middle lamellae is transverse by plasmodesmata which connects the cytoplasm of neighbouring cells.

37. **(a)** Cell membrane possesses protein and carbohydrate proteins are partially or wholly embedded in lipid bilayer.

38. **(b)** Middle lamellae is a layer mainly consists of calcium pectate which holds or glues the different neighbouring cells together.

39. **(c)** In plant cell, the cell wall and middle lamellae is transversed by plasmodesmata which connects the cytoplasm of neighbouring cells.

40. **(d)** Structure of cell membrane was proposed by Singer and Nicolson (1972); widely accepted as fluid mosaic model. According to this, the quasi-fluid nature of lipid enables lateral movement of proteins within the overall bilayer. Flip flop movement is rarely found in lipid molecules, whereas it remains absent in protein molecules.

41. **(d)** The cell membrane is composed of lipids that are arranged in a bilayer. The lipid component of the membrane mainly consists of phosphoglycerides.

42. **(b)** Structure of cell membrane was proposed by Singer and Nicolson (1972); widely accepted as fluid mosaic model. According to this, the quasi-fluid nature of lipid enables lateral movement of proteins within the overall bilayer. Lipids can rarely flip-flop while proteins can't.

43. **(c)** In fluid mosaic model, the cell membrane is composed of lipids, that are arranged in a bilayer. Lipids are arranged within a membrane with polar head towards outside and hydrophobic tail towards inner part. Lipid content of membrane mainly consist of phosphoglycerides.

44. **(a)** Cell wall of Gram +ve bacteria has a thick layer of peptidoglycan on outer side of plasma membrane, whereas in cell wall of Gram-ve bacteria, a thin peptidoglycan layer is covered by outer membrane from the surface of cell & innerly by plasma membrane.

45. **(d)** Prokaryotic cells lack membrane bound cell organelles. Operon is a feature of prokaryotic gene and histones are basic proteins found in nucleosomes of eukaryotic DNA.

46. **(b)** The desmosomes act as "spot welds" and keep the cells firmly together.

47. **(b)** Active transport takes place against the concentration gradient by expenditure of energy while passive transport is along the gradient.

48. **(d)** Glycolipids and glycoproteins are short carbohydrate chains protruding from lipids and proteins on cell membrane. They form hydrogen bonds and interact with molecules surrounding the cell, thus helps in cell recognition and cell adhesion.

49. **(c)** Intussusception is a condition is which the expansion of the cell wall in plants takes place as a result of introduction of new molecules of cellulose and protopectin into the already formed wall.

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50. **(a)** The primary cell wall of most plant cell is freely permeable to small molecules including proteins.

51. **(b)** In 1972, an improved model of structure of cell membrane was proposed by Singer & Nicolson, widely accepted as fluid-mosaic models.

52. **(c)** Jonathan Singer & G.Nicolson developed new ideas for membrane structure. Their proposal was fluid mosaic model, which is dominant model now. It has 2 key features a mosaic of proteins embedded in the membrane, and the membrane being a fluid bilayer of lipids.

53. **(c)** The principal components of plasma membrane are lipids, proteins and carbohydrate groups that are attached to some of the lipids and proteins.

54. **(d)** Membrane proteins are either extrinsic or intrinsic. Extrinsic membrane proteins are entirely outside of the membrane and intrinsic membrane proteins embedded in the membrane. Phospholipids (lipids) and carbohydrate are other two main components of plasma membrane.

55. **(c)** The endomembrane system include endoplasmic reticulum (ER), golgi complex, lysosomes and vacuoles. Since the functions of the mitochondria, chloroplast and peroxisomes are not coordinated with the above components, these are not considered as part of the endomembrane system.

6. **(b)** (A) and (C) only

The Golgi apparatus is involved in the synthesis of glycoproteins and glycolipids. It modifies proteins synthesised by ribosomes on the endoplasmic reticulum (ER).

57. **(c)** If the pH in lysosomes is increased to alkaline, hydrolytic enzymes, which are optimised to work in acidic conditions, will become inactive.

58. **(a)** Endoplasmic reticulum, Golgi complex, Lysosomes and vacuoles are included in endomembrane system because their functions are coordinated. Mitochondria is semi-autonomous cell organelle and ribosome is non-membranous cell organelle.

59. **(b)** Golgi bodies are the important site of formation of glycoproteins and glycolipids.

60. **(d)** Lysosomes bud off from *trans* face of Golgi bodies.

Precursor of lysosomal enzymes are synthesised by RER and then send to Golgi bodies for further processing.

61. **(b)** Golgi complex (apparatus) is a packaging organelle like ER. It modifies the proteins and lipids from ER and concentrate them and packs them into secretory vesicles.

62. **(d)** Phospholipid synthesis occurs in the cytosol adjacent to ER membrane. In smooth endoplasmic reticulum, phospholipids are synthesised from phosphatidic acid and 1, 2-diacylglycerol.

63. **(c)** The isolated lysosomal vesicles have been found to be very rich in almost all types of hydrolytic enzymes (hydrolases – lipases, proteases, carbohydrases) optimally active at the acidic pH.

64. **(d)** RER-Synthesis of protein.
SER-Synthesis of lipid and steroidal hormones.

65. **(c)** Vacuoles are meant for osmoregulation.

66. **(a)** SER: Ribosome absent, involved in lipid synthesis
RER: Ribosome present, involved in protein synthesis

67. **(c)** SER is the site for lipid synthesis.

68. **(a)** The major role of Golgi complex is in the post translational modification of protein and glycosidation of lipids. It also help in packaging.

69. **(d)** The endomembrane system includes endoplasmic reticulum (ER), Golgi complex, lysosome and vacuoles. Since the functions of the mitochondria, chloroplast and peroxisomes are not coordinated with the above components these are not considered as part of the endomembrane system.

70. **(c)** Golgi apparatus is the important site of formation of glycoproteins and glycolipids.

71. **(d)** Vacuole is membrane bound space found in the cytoplasm. It contains water, sap, excretory product. It is enclosed by tonoplast.

72. **(d)** Rough endoplasmic reticulum actively involved in protein synthesis. The materials to be packaged in the form of vesicles from the ER fuse with the *cis* face of Golgi apparatus. ER is in close association with Golgi to facilitate protein modification.

73. **(d)** Protein synthesis occurs in ribosome. Ribosome known as factory of protein. Ribosome are found in mitochondria, chloroplast, cytoplasm and on rough endoplasmic reticulum.

74. **(a)** Contractile vacuole expels out excess of water from cellular body of *Amoeba* & *Paramoecium* to regulate the osmotic concentration of cell.

75. **(c)** Glycosylation is a process of adding carbohydrate residues. It is a critical function of bio-synthetic secretory pathway in endoplasmic reticulum & Golgi apparatus.

76. **(b)** Lysosome is a membrane - bound organelle, that have spherical vesicles containing hydrolytic enzymes. These enzymes can breakdown many kinds of biomolecules.

77. **(a)** Ribosomes are the site of protein synthesis. They are present in the cytoplasm, mitochondria and endoplasmic membrane.

78. **(b)** Lysosomes, also called suicidal bags of the cells, are rich in hydrolytic enzymes that can break down many kinds of biomolecules such as carbohydrates, proteins, lipids and nucleic acids.

79. **(d)** Lysosomal vesicles are found to be very rich in almost all types of hydrolytic enzymes that are capable of digesting many kinds of biomolecules. Therefore, they also termed as "suicidal bags" of the cell.

80. **(d)** Golgi apparatus is a reticular structure found near the nucleus. They consist of many flat, disc - shaped sacs or cisternae.

81. **(a)** Number of proteins are synthesised by ribosomes on ER and are modified in cisternae of golgi apparatus before they are packaged in the form of vesicles (secretory), that are released out of the cell. Certain hydrolytic enzymes (which are ultimately proteins) are packaged in same manner by Golgi and released as lysosomes in cytoplasm.

82. **(a)** Peroxisomes are membrane-bound packets of oxidative enzymes. In plant cells, peroxisomes play a variety of roles including conversion of fatty acids to sugar and assisting chloroplasts in photorespiration.

83. **(c)** Lysosome is membrane-bound vesicular structure formed by the process of packaging in Golgi apparatus. They are rich in several hydrolytic enzymes.

84. **(c)** Golgi apparatus along with other membrane bound organelle is a characteristic feature of eukaryotes. Prokaryotic cells such as bacteria and cyanobacteria (blue - green algae) lack them.

85. **(a)** *Apparato reticolare* is an Italian word refers to Golgi apparatus discovered by Camillo Golgi.

86. **(c)** Contractile vacuole is a vacuole in some protozoans (such as *Amoeba* and *Paramoecium*) which expels excess liquid on contraction & hence involved in osmoregulation.

87. **(c)** Lysosomes and vacuoles do not contain DNA.

88. **(b)** In mitochondria, enzymes for electron transport are embedded in the inner membrane.

89. **(d)** Mitochondria is the site of aerobic oxidation of carbohydrates to generate ATP.

90. **(c)** Mitochondria and chloroplast both are semi-autonomous organelles and both contains single circular DNA, a few RNA molecules, ribosomes (70S) and the components required for the synthesis of proteins.

91. **(d)** A number of organised flattened membranous sacs called the thylakoids, are present in the stroma. Thylakoids are arranged in stacks like piles of coins called grana.

92. **(d)** Except ribosomes, nucleus, chloroplast and mitochondria have DNA. Ribosomes are composed of ribonucleic acid (RNA) and proteins and are not surrounded by any membrane.

93. **(a)** Mesosome helps in respiration in prokaryotes analogous to mitochondria.

94. **(a)** Centriole-Helps in cell division
Nucleolus-Sites for active RNA synthesis
Lysosome-Acidic pH

95. **(a)** Ribosome is found within other cell organelles like chloroplasts, endoplasmic reticulum (in plants) and mitochondria. That's why they are also known as an organelle within organelle.

96. **(c)** Ribosomes are non-membrane bound organelles found in all cells – both eukaryotic as well as prokaryotic. In prokaryotes, ribosomes are associated with the plasma membrane of the cell. They are about 15 nm by 20 nm in size and are made of two subunits - 50S and 30S units which when present together form 70S prokaryotic ribosomes. Ribosomes are the site of protein synthesis. Ribosomes are composed of ribonucleic acid and proteins

97. **(d)** The inner compartment is called the matrix. The outer membrane forms the continuous limiting boundary of the organelle. The inner membrane forms a number of infoldings called the cristae (sing.:crista) towards the matrix. The cristae increase the surface area.

98. **(a)** Ribosomes are the site of peptide synthesis. Ribosomes are the granular structures first observed under the electron microscope as dense particles by George Palade (1953). They are composed of ribonucleic acid (RNA) and proteins and are not surrounded by any membrane.

99. **(a)** The guard cells possess chloroplasts and regulate the opening and closing of stomata.

100. **(a)** Chloroplast and mitochondria both have DNA. Chloroplast having variable length (5-10 μm) and width (2-4 μm) while mitochondria having length (1.0 - 4.1 μm) and width (0.5μm). Both are double membrane bound. Thylakoid membrane is found in chloroplast only.

101. **(c)** Enzymes of ETC are located in inner mitochondrial membrane.

102. **(b)** In chloroplast, chlorophyll pigments are responsible for trapping light energy essential for photosynthesis. Chlorophyll pigments are present in the intergranal thylakoids.

103. **(d)** The matrix of mitochondria and stroma of chloroplasts contains small double stranded circular DNA molecules. Hence, they contribute to extranuclear inheritance.

104. **(b)** The chloroplasts contain chlorophyll and carotenoid pigments for trapping light energy essential for performing photosynthesis in plants. These chlorophyll pigments are present in organised flattened membranous sacs called thylakoids.

105. **(c)** Nissl granules are particles seen within the cell bodies of neurons, consisting of granular endoplasmic reticulum and polyribosomes. They are rich in RNA and stain strongly with basic dyes. They are named after F.Nissl, a German neurologist.

106. **(b)** Quiescent cells are cells found in resting state. One of the quiescent cells feature is a much more packed DNA that reduces the size of nucleus. Cytoplasm is also light as in quiescence, cell is inactivated in terms of cell cycle and division.

107. **(a)** Ribosomes present on the surface of nuclear and rough endoplasmic reticulum membrane, are the sites of protein synthesis. Transcripts of mRNA travels from nucleus to RER lumen, where they are translated by ribosomes.

108. **(b)** Our genetic material, DNA, is present in nucleus where it provide all the genetic information but cell organelles present in cytoplasm, i.e., chloroplast & mitochondria, also have their own DNA, called extranuclear DNA.

109. **(a)** Protochlorophyll is a Mg-containing pigment that is present in etiolatied leaves and seedlings which develop in dark and that is converted to chlorophyll by reduction (addition of H^+) under the influence of light.

110. **(d)** In mitochondria, the inner membrane forms a number of infoldings to increase surface area, called cristae. It carries the electron transport chain where ATP synthesis takes place by oxidation - reduction reactions.

111. **(c)** The inner membrane of the mitochondria is infolded variously to form involutions called cristae.

112. **(d)** Based on the type of pigments, plastids can be classified into chloroplasts, chromoplasts and leucoplast. They are structurally similar and can transform from one form to another.

113. **(c)** Oxysomes of F_0 - F_1 particles occurs on inner mitochondrial membrane.

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114. (c) Ribosomes are cell structure that makes protein. They are the site of translation & needed to make protein from all amino acids. They can be free or bound to endoplasmic reticulum.

115. (d) Ribosomes were discovered by Palade.

116. (d) A polyribosome (or polysome) is a complex of an mRNA molecule associated with 2 or more ribosomes that act to translate mRNA coding into polypeptide chain.

117. (d) The cytoskeleton in a cell is involved in many functions such as mechanical support, motility, maintenance of the shape of the cell.

118. (d) The smooth endoplasmic reticulum is the major site for synthesis of lipid. In animal cells lipid-like steroidal hormones are synthesised in SER.
RER is frequently observed in the cells actively involved in protein synthesis and secretion. They are extensive and continuous with the outer membrane of the nucleus.
Golgi apparatus is the important site of formation of glycoproteins and glycolipids.
The centrioles form the basal body of cilia or flagella, and spindle fibres that give rise to spindle apparatus during cell division in animal cells.

119. (b) Microtubules are the constituents of spindle fibres, centrioles and cilia.

120. (c) Microfilament has a diameter of 5-7 nm and made up of single monomer.

121. (b) Centriole-Basal body of cilia or flagella
Chlorophyll-Thylakoid
Cristae-Infoldings in mitochondria
Ribozymes-Nucleic acid

122. (b) An elaborate network of filamentous proteinaceous structures present in cytoplasm referred to as the cytoskeleton.

123. (d) An elaborate network of filamentous proteinaceous structures present in cytoplasm referred to as the cytoskeleton.

124. (a) Cilia are hair like outgrowths of cell membrane. The core of cilia has nine pairs of doublets of radially arranged peripheral microtubules and a pair of centrally located microtubules. Microtubule is made up of tubulin protein.

125. (b) Eukaryotic & prokaryotic flagella serve similar functions but their structure & dynamics (movement) are completely different. Eukaryotic flagella are microtubule based structure, and are anchored at cell membrane by centrioles. Prokaryotic flagella are made up of protein flagellin. Prokaryotic flagella show rotatory movement while bending movement is shown by eukaryotic flagella.

126. (a) Microtubules are component of cytoskeleton, found throughout the cytoplasm. It gives the cell shape and keep its organelles in place. They are responsible for various eukaryotic movements, such as nucleic and cell division (spindle fibres & centrioles) and flagellar motility.

127. (a) Ribosomes are granular structures; composed of RNA & proteins. They are not surrounded by any membrane.

128. (a) Microtubules are skeletal framework of cell. They present in spindle fibres and thus assist in the divisio cytoplasm and its content during cell division.

129. (a) Centrioles are minute cylindrical organelles invol in development of spindle fibres in cell division. They found near the nucleus in animal cells only.

130. (a) The flagellin sub-units are arranged in helical spirals form a hollow cylinder.

131. (c) Centromere is a part of a chromosome that attaches t spindle during cell division.

132. (b) Based on the position of the centromere, the chromoso can be classified into four types.
(i) Metacentric chromosome – It has middle centrom forming two equal arms of the chromosome.
(ii) Sub-metacentric chromosome – It has centromere slig away from the middle of the chromosome resulting i one shorter arm and one longer arm.
(iii) Acrocentric chromosome – In this, the centromer situated close to its end forming one extremely short a one very long arm.
(iv) Telocentric chromosome – It has a terminal centrom

133. (d) Mature sieve tube elements have peripheral cytopla and large vacuole. The nucleus is absent in it.

134. (b) The inner membrane of mitochondria forms a numbe infoldings called the cristae towards the matrix.
Thylakoids are organized flattened membranous sacs pres in the stroma of chloroplasts.
Every chromosome essentially has a primary constrict or the centromere. Centromere holds two chromatids t chromosome.
Cisternae are flat, disc-shaped sacs stacked parallel to ea other in Golgi apparatus.

135. (d) In metacentric chromosomes, the centromere is present the middle thus forming two equal arms of the chromosom

136. (c) Nucleolus is a site for active ribosomal RNA synthes Larger and more numerous nucleoli are present in ce actively carrying out protein synthesis.

137. (b) Shorter arm and longer arm of chromosome is designat as 'p' arm and 'q' arm respectively.

138. (d) Nucleolus is a small dense spherical structure in nucle of cell. It is the site of ribosome biosynthesis.

139. (d) In acrocentric chromosomes, the centromere is situat close to its ends forming one extremely short and one ve long arm.

140. (b) Nucleus is a double membrane bound organelle. Its out membrane usually remains continuous with the endoplasm reticulum bearing ribosomes.

141. (c) Polytene chromosomes first seen in salivary gland *Chironomus tantans*. They show puff or balbiani rings whi develops lateral loops where DNA becomes active a produce copies of RNA

142. (a) In chloroplasts, a number of organised flattened membranous sacs called the thylakoids, are present in the stroma. The inner mitochondrial membrane forms a number of infoldings called the cristae towards the matrix. Golgi bodies consists of many flat, disc-shaped sacs or cisternae, stacked parallel to each other, of 0.5 µm to 1.0 µm diameter.

143. (c) Ribosomes are the site of protein synthesis. Nucleolus is a site of active ribosomal RNA synthesis.

144. (b) Mature RBC are enucleate. They do not have nucleus

145. (d) The cap-like structure present at the end of chromosome are called telomere. There are 4 telomeres are present in each chromosome 2 in each chromatid.

146. (a) Eukaryote ribosomes are produced and assembled in the nucleolus.

147. (b) Chloroplast and mitochondria have their own DNA, called extranuclear DNA. Generally, a cell have all the genetic information inside nucleus in the form of chromosome.

148. (c) Telomere is a region of repetitive nucleotide sequence at each end of a chromosome, which protects the end of chromosome from deterioration or from fusion with neighboring chromosome.

149. (d) Each chromosome at the anaphase stage of a bone marrow celll in our body has only one chromatid.

150. (c) Polytene chromosome are large chromosomes with thousands of DNA strands commonly founds in dipteran flies'larvae. It was first reported in salivary glands of *Chironomus* larva by Balbiani (1881).

151. (c) Chromocentre is densely stained mass of heterochromatin in polytene chromosomes found in salivary glands of *Drosophila*.

152. (b) Balbiani rings (puffs) are sites of RNA and protein synthesis.

153. (d) X-ray crystallography is a technique used for determining the atomic and molecular structure in three-dimensional space. It can reveal the detailed 3-D structures of thousands of proteins.

154. (d) Polytene chromosomes are large chromosomes that are produced when repeated round of DNA replication without cell division takes place. In this, homologous chromosomes are paired to each other & make up a giant chromosome with 1000 of chromatin threads.

155. (b) *Acetabularia*, used in Hammerling's nucleocytoplasmic experiment, is unicellular uninucleate green algae. Hammerling's experiment of *Acetabularia* involved exchanging rhizoid and stalk. Presence of hereditary information in the nucleous was proved by the work of Hammerling on single celled alga *Acetabularia*.

156. (b) RNA content of a cell depend very much on its developmental stages. RNA is present in a cell as messenger RNA (mRNA, that carry protein blueprint from DNA to ribosomes), ribosomal RNA and transfer RNA (tRNA).

157. (a) Lysosome, mitochondria and plastids are membrane bound organelles. Nucleolus is a small dense structure in the nucleus of a cell during interphase and it is the site of rRNA transcription and ribosome assembly.

158. (c) Hammerling's experiment of *Acetabularia* involved exchanging rhizoid and stalk.

159. (d) Nucleoproteins are proteins that are structurally associated with nucleic acid, so like other proteins they are also synthesised in the cytoplasm.

160. (c) *Acetabularia* is a genus of green algae. It is a single-celled organism, but gigantic in size and complex in form, making it an excellent model organism for studying cell biology.

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9 Biomolecules

Analysis of Chemical Composition

1. Given below are two statements: *(2022 Re)*

Statement I: Amino acids have a property of ionizable nature of — NH_2 and — COOH groups, hence have different structures at different pH.

Statement II: Amino acids can exist as Zwitter ionic form at acidic and basic pH.

In the light of the above statements, choose the most appropriate answer from the options given below:

a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both Statement I and Statement II are incorrect
d. Statement I is correct but Statement II is incorrect

2. Read the following statements and choose the set of correct statements [MR*] *(2022)*

A. Lecithin found in the plasma membrane is a glycolipid
B. Saturated fatty acids possess one or more C=C bonds
C. Gingelly oil has lower melting point, hence remains as oil in winter
D. Lipids are generally insoluble in water but soluble in some organic solvents
E. When fatty acid is esterified with glycerol, monoglycerides are formed

Choose the correct answer from the options given below.

a. A, B and D only b. A, B and C only
c. A, D and E only d. C, D and E only

3. Following are the statements with reference to 'lipids'.

A. Lipids having only single bonds are called unsaturated fatty acids.
B. Lecithin is a phospholipid.
C. Trihydroxy propane is glycerol.
D. Palmitic acid has 20 carbon atoms including carboxyl carbon.
E. Arachidonic acid has 16 carbon atoms.

Choose the correct answer from the options given below. [MR*] *(2021)*

a. C & D only b. B & C only
c. B & E only d. A & B only

4. Identify the basic amino acid from the following. *(2020)*

a. Glutamic acid b. Lysine
c. Valine d. Tyrosine

5. Identify the statement which is incorrect. *(2020-Covid)*

a. Glycine is an example of lipids
b. Lecithin contains phosphorus atom in its structure
c. Tyrosine possesses aromatic ring in its structure
d. Sulphur is an integral part of cysteine

6. A typical fat molecule is made up of: *(2016 - I)*

a. Three glycerol molecules and one fatty acid molecule
b. One glycerol and three fatty acid molecules
c. One glycerol and one fatty acid molecule
d. Three glycerol and three fatty acid molecules

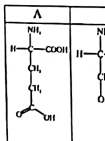
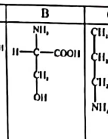
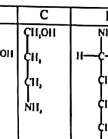
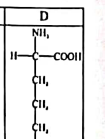
7. A phosphoglyceride is always made up of: *(2013)*

a. A saturated or unsaturated fatty acid esterified to a phosphate group which is also attached to a glycerol molecule
b. Only a saturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
c. Only an unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
d. A saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached

8. Which one of the following biomolecules is correctly characterised? *(2012 Mains)*

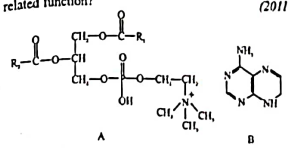
a. Lecithin - a phosphorylated glyceride found in cell membrane
b. Palmitic acid - an unsaturated fatty acid with 18 carbon atoms
c. Adenylic acid - adenosine with a glucose phosphate molecule
d. Alanine amino acid - Contains an amino group and an acidic group anywhere in the molecule

9. Which one out of A – D given below correctly represents the structural formula of the basic amino acid? *(2012 Pre)*

A	B	C	D
			

a. B b. C
c. D d. A

10. Which one of the following structural formulae of two organic compounds is correctly identified along with its related function? *(2011 Pre)*



A B

a. A : Lecithin - a component of cell membrane
b. B : Adenine - a nucleotide that makes up nucleic acids
c. A : Triglyceride - major source of energy
d. B : Uracil - a component of DNA

11. 98% of living organism is formed of six element-carbon, hydrogen, nitrogen, oxygen and: *(2007)*

a. S and Mg b. Mg and Na
c. Ca and P d. P and S

12. The major portion of the dry weight of plants comprises of: *(2003)*

a. Nitrogen, phosphorus and potassium
b. Calcium, magnesium and sulphur
c. Carbon, nitrogen and hydrogen
d. Carbon, hydrogen and oxygen

13. An important step in the manufacture of pulp in paper industry from woody tissues of plants is: [OS] *(2005)*

a. Preparation of pure cellulose by removing lignin
b. Treatment of wood with chemicals for breakdown of cellulose
c. Removal of oil by suitable chemicals
d. Removal of water from wood by prolonged heating at 50°C

14. The major role of minor elements inside living organisms is to act as: *(2003)*

a. Co-factors of enzymes
b. Building blocks of important amino adds
c. Constituent of hormones
d. Binder of cell structure

15. Lipids are insoluble in water because lipids molecules are: *(2002)*

a. Hydrophilic b. Hydrophobic
c. Neutral d. Zwitter ions

16. Spoilage of oil can be detected by which fatty acid? [OS] *(2001)*

a. Oleic acid b. Linolenic acid
c. Linoleic acid d. Erucic acid

17. ATP is: *(2000)*

a. Nucleotide b. Nucleoside
c. Nucleic acid d. Vitamin

18. Which of the following does not contain metal? *(1999)*

a. Glycoproteins b. Ferritin
c. Cytochromes d. Chromoproteins

19. The four elements that make up 99% of all elements found in a living system are: *(1994)*

a. C, H, O and P b. C, N, O and P
c. H, O, C and N d. C, H, O and S

20. Glycogen is a polymer of: *(1993)*

a. Galactose b. Glucose
c. Fructose d. Sucrose

21. Living cell contains 60%-95% water. Water present in human body is: *(1992)*

a. 60 - 65% b. 50 - 55%
c. 75 - 80% d. 65 - 70%

Primary & Secondary Metabolites

22. Which of the following is not a secondary metabolite? *(2023-Manipur)*

a. Curcumin b. Morphine
c. Anthocyanin d. Lecithin

23. Match List-I with List-II. [MR*] *(2023-Manipur)*

List-I		List-II	
(A)	Terpenoids	(I)	Codeine
(B)	Lectins	(II)	Diterpene
(C)	Alkaloids	(III)	Ricin
(D)	Toxins	(IV)	Concanavalin A

Choose the correct answer from the options given below:

a. A-II, B-IV, C-III, D-I b. A-II, B-I, C-IV, D-III
c. A-II, B-III, C-I, D-IV d. A-II, B-IV, C-I, D-III

24. Match List-I with List-II: [MR*] *(2022 Re)*

List-I		List-II	
(A)	Adenine	(I)	Pigment
(B)	Anthocyanin	(II)	Polysaccharide
(C)	Chitin	(III)	Alkaloid
(D)	Codeine	(IV)	Purine

Choose the correct answer from the options given below.

a. A-I, B-IV, C-III, D-II b. A-IV, B-I, C-II, D-III
c. A-IV, B-III, C-II, D-I d. A-III, B-I, C-IV, D-III

25. Identify the incorrect pair. *(2021)*

a. Toxin - Abrin b. Lectins - Concanavalin A
c. Drugs - Ricin d. Alkaloids - Codeine

26. Which of the following are not secondary metabolites in plants? *(2021)*

a. Amino acids, glucose b. Vinblastin, curcumin
c. Rubber, gums d. Morphine, codeine

27. Concanavalin A is *(2019)*

a. An alkaloid b. An essential oil
c. A lectin d. A pigment

28. In plants inulin and pectin are: *(2001)*
a. Reserved material b. Wastes
c. Excretory material d. Insect attracting material

Biomacromolecules, Proteins

29. Given below are two statements: **[MR*]** *(2023)*

Statement I: A protein is imagined as a line, the left end represented by first amino acid (C-terminal) and the right end represented by last amino acid (N-terminal)

Statement II: Adult human haemoglobin, consists of 4 subunits (two subunits of α type and two subunits of β type.)

In the light of the above statements, choose the correct answer from the options given below:
a. Statement I is false but Statement II is true.
b. Both Statement I and Statement II are true.
c. Both Statement I and Statement II are false.
d. Statement I is true but Statement II is false.

30. Primary proteins are also called as polypeptides because: *(2022 Re)*
a. They can assume many conformations
b. They are linear chains
c. They are polymers of peptide monomers
d. Successive amino acids are joined by peptide bonds

31. Match List-I with List-II. **[MR*]** *(2022)*

List-I (Biological Molecules)		List-II (Biological function)	
(A)	Glycogen	(i)	Hormone
(B)	Globulin	(ii)	Biocatalyst
(C)	Steroids	(iii)	Antibody
(D)	Thrombin	(iv)	Storage product

Choose the correct answer from the options given below.
a. A-iv B-iii C-i D-ii
b. A-iii B-ii C-iv D-i
c. A-iv B-ii C-i D-iii
d. A-ii B-iv C-iii D-i

32. Which one of the following is the most abundant protein in the animals? *(2020)*
a. Collagen b. Lectin
c. Insulin d. Haemoglobin

33. Which of the following glucose transporters is insulin-dependent? *(2019)*
a. GLUT I b. GLUT II
c. GLUT III d. GLUT IV

34. Which of the following are not polymeric? *(2017-Delhi)*
a. Nucleic acids b. Proteins
c. Polysaccharides d. Lipids

35. Which of the following is the least likely to be involved in stabilising the three–dimensional folding of most proteins? **[OS]** *(2016 - II)*
a. Hydrophobic interaction b. Ester bonds
c. Hydrogen bonds d. Electrostatic interaction

36. Which one is the most abundant protein in the animal world? *(2012 Pre)*
a. Insulin b. Trypsin
c. Haemoglobin d. Collagen

37. What should be given if an anaemic person has large, immature nucleated erythrocytes? **[OS]** *(2006)*
a. Iron
b. Thiamine
c. Folic acid and cobalamine
d. Riboflavin

38. Which group of three of following statements (A - E) contains all the three statements regarding beriberi?
A. A crippling disease prevalent among the native population of Africa.
B. A deficiency disease caused by lack of thiamine
C. A nutritional disorder in infants and young children
D. Occurs in those countries where the staple diet is polished rice
E. The symptoms are pain from neuritis, paralysis, muscle wasting, progressive edema, mental deterioration and finally heart failure **[OS]** *(2005)*
a. B, D, E b. A, B, D
c. A, C, E d. B, C, E

39. The richest sources of vitamin B_{12} are: **[OS]** *(2004)*
a. Chocolate and green gram
b. Rice and hen's egg
c. Carrot and chicken's breast
d. Goat's liver and *Spirulina*

40. Which one of the following is the correct matching of a vitamin, its nature and its deficiency disease? **[OS]** *(2004)*
a. Vitamin K - Fat soluble - Beri-Beri
b. Vitamin A - Fat soluble - Beri-Beri
c. Vitamin K - Water soluble - Pellagra
d. Vitamin A - Fat soluble - Night blindness

41. Which one of the following pairs is not correctly matched? **[OS]** *(2004)*
a. Vitamin B_6 - Loss of appetite
b. Vitamin B_1 - Beri-beri
c. Vitamin B_2 - Pellagra
d. Vitamin B_{12} - Pernicious anemia

42. Which one of the following pairs is not correctly matched? **[OS]** *(2003)*
a. Vitamin C – Scurvy
b. Vitamin B_2 – Pellagra
c. Vitamin B_{12} – Pernicious anaemia
d. Vitamin B_6 – Beri-beri

43. Collagen is: *(2002)*
a. Fibrous protein b. Globular protein
c. Lipid d. Carbohydrate

44. Most abundant organic compound on earth is: *(2001)*
a. Protein b. Cellulose
c. Lipids d. Steroids

45. Which one correctly matched? **[OS]** *(2001)*
a. Vit. E – Tocopherol b. Vit. D – Riboflavin
c. Vit. B – Calciferol d. Vit. A – Thiamine

46. Essential amino acid is: *(2000)*
a. Phenylalanine b. Glycine
c. Aspartic acid d. Serine

47. Secondary structure of protein, which is attached to lipid layer and lining the pores of cell membrane will be: **[OS]** *(1999)*
a. α-helix b. β-strand
c. β-chain d. Random

48. Which protein found in maximum amount? *(1999)*
a. Catalase b. Zinc carbonic anhydrase
c. Transferase d. RuBisCO

49. Pantothenic acid and biotin are associated with: **[OS]** *(1999)*
a. Vitamin D b. Vitamin B complex
c. Vitamin K d. Vitamin E

50. Which one is wrong pair? **[OS]** *(1999)*
a. Scurvy - Vitamin C
b. Rickets - Vitamin D
c. Night blindness (Xerophthalmia) - Vitamin A
d. Beri beri - Vitamin K

51. Vitamin which induces maturation of R.B.C.: **[OS]** *(1998)*
a. B_1 b. A
c. B_{12} d. D

52. Variations in proteins are due to: *(1998)*
a. Sequence of amino acids
b. Number of amino acids
c. R-group
d. None

53. The vitamin C or ascorbic acid prevents: **[OS]** *(1995)*
a. Scurvy b. Antibody synthesis
c. Rickets d. Pellagra

54. Calcium deficiency in the body occurs in the absence of: **[OS]** *(1994)*
a. Vitamin C b. Vitamin D
c. Vitamin B d. Vitamin E

55. Prolonged deficiency of nicotinic acid causes: *(1994)*
a. Pellagra b. Xerophthalmia
c. Osteomalacia d. Anaemia

56. Amino acids are mostly synthesised from: *(1992)*
a. Mineral salts b. Fatty acids
c. Volatile acids d. α-ketoglutaric acid

57. Amino acids are produced from: *(1992)*
a. Proteins b. Fatty acids
c. Essential oils d. α-keto acids

Polysaccharides, Nucleic Acids & Types of Bond

58. Cellulose does not form blue colour with Iodine because *(2023)*
a. It breaks down when iodine reacts with it.
b. It is a disaccharide.
c. It is a helical molecule.
d. It does not contain complex helices and hence cannot hold iodine molecules.

59. Match List-I with List-II. **[MR*]** *(2023-Manipur)*

List-I		List-II	
(A)	Protein	(I)	C = C double bonds
(B)	Unsaturated fatty acid	(II)	Phosphodiester bond
(C)	Nucleic acid	(III)	Glycosidic bonds
(D)	Polysaccharide	(IV)	Peptide bonds

Choose the correct answer from the options given below:
a. A-II, B-I, C-IV, D-III b. A-IV, B-III, C-I, D-II
c. A-IV, B-I, C-II, D-III d. A-I, B-IV, C-III, D-II

60. Inulin is a polymer of: *(2023-Manipur)*
a. Fructose b. Galactose
c. Amino acids d. Glucose

61. Exoskeleton of arthropods is composed of: *(2022)*
a. Glucosamine b. Cutin
c. Cellulose d. Chitin

62. Match List - I with List - 2 *(2021)*

	List- 1		List - 2
A.	Protein	(i)	C = C double bonds
B.	Unsaturated fatty acid	(ii)	Phosphodiester bonds
C.	Nucleic acid	(iii)	Glycosidic bonds
D.	Polysaccharide	(iv)	Peptide bonds

Choose the correct answer from the options given below.
a. A-i B-iv C-iii D-ii
b. A-ii B-i C-iv D-iii
c. A-iv B-iii C-i D-ii
d. A-iv B-i C-ii D-iii

63. Identify the substances having glycosidic bond and peptide bond, respectively in their structure: *(2020)*
a. Glycerol, trypsin b. Cellulose, lecithin
c. Inulin, insulin d. Chitin, cholesterol

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64. Match the following: *(2020-Covid)*

1.	Aquaporin	(i)	Amide
2.	Asparagine	(ii)	Polysaccharide
3.	Abscisic acid	(iii)	Polypeptide
4.	Chitin	(iv)	Carotenoids

Select the correct option:

	(1)	(2)	(3)	(4)
a.	(ii)	(iii)	(iv)	(i)
b.	(ii)	(i)	(iv)	(iii)
c.	(iii)	(i)	(ii)	(iv)
d.	(iii)	(i)	(iv)	(ii)

65. The two functional groups characteristic of sugars are: *(2018)*

a. Hydroxyl and methyl b. Carbonyl and methyl
c. Carbonyl and phosphate d. Carbonyl and hydroxyl

66. Which one of the following statements is wrong? *(2016 - I)*

a. Sucrose is a disaccharide
b. Cellulose is a polysaccharide
c. Uracil is a pyrimidine
d. Glycine is a sulphur containing amino acid

67. The chitinous exoskeleton of arthropods is formed by the polymerisation of: *(2015 Re)*

a. D-glucosamine
b. N-acetyl glucosamine
c. Lipoglycans
d. Keratin sulphate and chondroitin sulphate

68. Which of the following biomolecules does have phosphodiester bond? *(2015 Re)*

a. Monosacchardes in polysaccharide
b. Amino acids in a polypeptide
c. Nucleic acids in a nucleotide
d. Fatty acids in a diglyceride

69. Which one of the following is a non-reducing carbohydrate? *(2014)*

a. Ribose 5-phosphate b. Maltose
c. Sucrose d. Lactose

70. Given below is the diagrammatic representation of one of the categories of small molecular weight organic compounds in the living tissues. Identify the category shown and the one blank component "X" in it: *(2012 Pre, 2008)*

Category	Component
a. Nucleoside	Uracil
b. Cholesterol	Guanine
c. Amino acid	NH_2
d. Nucleotide	Adenine

71. During prolonged fasting, in what sequence are the following organic compounds used up by the body? *(2003)*

a. First carbohydrates, next fats and lastly proteins
b. First fats, next carbohydrates and lastly proteins
c. First carbohydrates, next proteins and lastly lipids
d. First proteins, next lipids and lastly carbohydrates

72. Which is a reducing sugar? *(2002)*

a. Galactose b. Gluconic acid
c. β-methyl galactoside d. Sucrose

73. Proteoglycan in cartilages which is part of polysaccharides: **[OS]** *(2000)*

a. Chondroitin b. Ossein
c. Casein d. Cartilegen

74. Lactose composed of: *(1998)*

a. Glucose + galactose b. Glucose + fructose
c. Glucose + glucose d. Glucose + mannose

75. True statement for cellulose molecule: **[OS]** *(1998)*

a. β-1-4 linkage, unbranched
b. β-1-4 linkage, branched
c. α-1-4 linkage, branched
d. β-1-6 linkage, unbranched

76. In which of the following groups are all polysaccharides? *(1996)*

a. Sucrose, glucose and fructose
b. Maltose, lactose and fructose
c. Glycogen, sucrose and maltose
d. Glycogen, cellulose and starch

77. What are the most diverse molecules in the cell? *(1996)*

a. Lipids b. Mineral salts
c. Proteins d. Carbohydrates

78. Which purine base is found in RNA? *(1996)*

a. Thymine b. Uracil
c. Cytosine d. Guanine

79. A polysaccharide which is synthesised and stored in liver cells is: *(1995)*

a. Arabinose b. Glycogen
c. Lactose d. Galactose

80. Which of the following nucleotide sequences contains 4 pyrimidine bases? *(1994)*

a. GATCAATGC b. GCUAGACAA
c. UAGCGGUAA d. Both (b) and (c)

81. Which is wrong about nucleic acids? *(1993)*

a. DNA is single stranded in some viruses
b. RNA is double stranded occasionally
c. Length of one helix is 45Å in B-DNA
d. One turn of Z-DNA has 12 bases

82. In RNA, thymine is replaced by: *(1992)*

a. Adenine b. Guanine
c. Cytosine d. Uracil

83. Adenine is: *(1992)*

a. Purine b. Pyrimidine
c. Nucleoside d. Nucleotide

84. A nucleotide is formed of: *(1991)*

a. Purine, pyrimidine and phosphate
b. Purine, sugar and phosphate
c. Nitrogen base, sugar and phosphate
d. Pyrimidine, sugar and phosphate

85. DNA is composed of repeating units of: *(1991)*

a. Ribonucleosides b. Deoxyribonucleosides
c. Ribonucleotides d. Deoxyribonucleotides

86. The basic unit of nucleic acid is: *(1991)*

a. Pentose sugar b. Nucleoid
c. Nucleoside d. Nucleotide

87. RNA does not possess: *(1988)*

a. Uracil b. Thymine
c. Adenine d. Cytosine

Enzymes

88. Malonate inhibits the growth of pathogenic bacteria by inhibiting the activity of *(2023)*

a. Dinitrogenase b. Succinic dehydrogenase
c. Amylase d. Lipase

89. Given below are two statements: **[MR*]** *(2023)*

Statement I: Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

Statement II: When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as competitive inhibitor.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is false but statement II is true.
b. Both Statement I and Statement II are true.
c. Both Statement I and Statement II are false.
d. Statement I is true but Statement II is false.

90. In the enzyme which catalyses the breakdown of: *(2022 Re)*

$H_2O_2 \rightarrow H_2O + O_2$

the prosthetic group is:

a. Niacin
b. Nicotinamide adenine dinucleotide
c. Haem
d. Zinc

91. Match the following. Choose the correct option from the following: **[MR*]** *(2020)*

	Column-I		Column-II
1.	Inhibitor of catalytic activity	(i)	Ricin
2.	Possess peptide bonds	(ii)	Malonate
3.	Cell wall material in fungi	(iii)	Chitin
4.	Secondary metabolite	(iv)	Collagen

	(1)	(2)	(3)	(4)
a.	(iii)	(i)	(iv)	(ii)
b.	(iii)	(iv)	(i)	(ii)
c.	(ii)	(iii)	(i)	(iv)
d.	(ii)	(iv)	(iii)	(i)

92. Consider the following statement :

A. Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group.
B. A complete catalytic active enzyme with its bound prosthetic group is called apoenzyme.

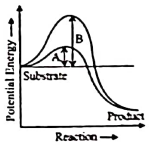
Select the correct option. *(2019)*

a. Both (A) and (B) are true.
b. (A) is true but (B) is false.
c. Both (A) and (B) are false.
d. (A) is false but (B) is true.

93. Which one of the following statements is correct with reference to enzymes? *(2017-Delhi)*

a. Apoenzyme = Holoenzyme + Coenzyme
b. Holoenzyme = Apoenzyme + Coenzyme
c. Coenzyme = Apoenzyme + Holoenzyme
d. Holoenzyme = Coenzyme + Cofactor

94. Which of the following describes the given graph correctly? *(2016 - I)*



a. Endothermic reaction with energy A in absence of enzyme and B in presence of enzyme
b. Exothermic reaction with energy A in absence of enzyme and B in presence of enzyme
c. Endothermic reaction with energy A in presence of enzyme and B in absence of enzyme
d. Exothermic reaction with energy A in presence of enzyme and B in absence of enzyme.

95. A non-proteinaceous enzyme is: *(2016 - II)*

a. Ligase b. Deoxyribonuclease
c. Lysozyme d. Ribozyme

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96. Which one of the following statements is incorrect? *(2015)*
a. The competitive inhibitor does not affect the rate of breakdown of the enzyme substrate complex
b. The presence of the competitive inhibitor decreases the K_m of the enzyme for the substrate
c. A competitive inhibitor reacts with the enzyme to form an enzyme inhibitor complex
d. In competitive inhibition, the inhibitor molecule is not chemically changed by the enzyme

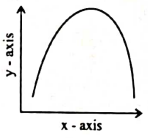
97. Select the option which is not correct with respect to enzyme action: *(2014)*
a. Malonate is a competitive inhibitor of succinic dehydrogenase
b. Substrate binds with enzyme at its active site
c. Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate
d. A non-competitive inhibitor binds the enzyme at a site distinct from that which binds the substrate

98. The essential chemical components of many coenzymes are: *(2013)*
a. Vitamins b. Proteins
c. Nucleic acids d. Carbohydrates

99. Transition state structure of the substrate formed during an enzymatic reaction is: *(2013)*
a. Permanent and stable
b. Transient but stable
c. Permanent but unstable
d. Transient and unstable

100. For its activity, carboxypeptidase requires: *(2012 Mains)*
a. Zinc b. Iron
d. Niacin d. Copper

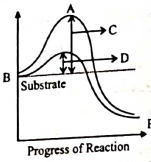
101. The curve given below show enzymatic activity with relation to three conditions (pH, temperature and substrate concentration)



What do the two axis's (x and y) represent? *(2011 Pre)*

	x-axis	y-axis
a.	Enzymatic activity	pH
b.	Enzymatic activity	Temperature
c.	Temperature	Enzyme Activity
d.	Substrate concentration	Enzymatic Activity

102. The figure given shows the conversion of substrate into product by an enzyme. In which one of the four options (A - D) the components of the reaction labeled a,b,c, d are identified correctly? *(2010 Mains)*



	A	B	C	D
a.	Potential energy	Transition state	Activation energy with enzyme	Activation energy without enzyme
b.	Transition state	Potential energy	Activation energy without enzyme	Activation energy with enzyme
c.	Potential energy	Transition state	Activation energy with enzyme	Activation energy without enzyme
d.	Activation energy with enzyme	Transition state	Activation energy without enzyme	Potential energy

103. Three of the following statements about enzymes are correct and one is wrong. Which one is wrong? *(2010 Mains)*
a. Enzymes are denatured at high temperature but in certain exceptional organisms they are effective even at 80° – 90°C.
b. Enzymes require optimum pH for maximal activity.
c. Most enzymes are proteins but some are lipids.
d. Enzymes are highly specific.

104. An organic substance bound to an enzyme and essential for its activity is: *(2006)*
a. Isoenzyme b. Coenzyme
c. Apoenzyme d. Holoenzyme

105. Which statement regarding enzyme inhibition is correct? *(2005)*
a. Competitive inhibition occurs when a substrate competes with enzyme for binding to inhibitor protein
b. Competitive inhibition occurs when the substrate and the inhibitor compete of active site on the enzyme
c. Non-competitive inhibition of an enzyme can be overcome by adding large amount of substrate
d. Non-competitive inhibitors often bind to the enzyme irreversibly

106. Catalytic efficiency of two different enzymes is compared by their: *(2005)*
a. Product b. Molecular size
c. K_m value d. pH optimum value

107. Telomerase is an enzyme which is: [OS] *(2005)*
a. Simple protein b. RNA
c. Ribonucleoprotein d. Repetitive DNA.

108. Hydrolytic enzymes which act on low pH are called as: [OS] *(2002)*
a. Protease b. α-Amylase
c. Hydrolases d. Peroxidase

109. Which factor is responsible for inhibition of enzymatic process during feedback? *(2000)*
a. Substrate b. Enzymes
c. End product d. Temperature

110. Which of the following have carbohydrate as prosthetic group? *(2000)*
a. Glycoprotein b. Chromoprotein
c. Lipoprotein d. Nucleoprotein

111. Role of enzyme in reactions: *(2000)*
a. Decrease activation energy
b. Increase activation energy
c. Inorganic catalyst
d. None of the above

112. Co-factor (prosthetic group) is a part of holoenzyme. It is: *(1997)*
a. Loosely attached organic part
b. Loosely attached inorganic part
c. Accessory non-protein substance attached firmly
d. None of these

113. Which is a typical example of 'feedback inhibition'? *(1996)*
a. Cyanide and cytochrome reaction
b. Sulpha drugs and folic acid synthesiser bacteria
c. Allosteric inhibition of hexokinase by glucose 6-phosphate
d. Reaction between succinic dehydrogenase and succinic acid

114. Enzymes having slightly different molecular structure but performing identical activity are: *(1991)*
a. Holoenzymes b. Isoenzymes
c. Apoenzymes d. Coenzymes

Answer Key

1. (b)	2. (d)	3. (b)	4. (b)	5. (a)	6. (b)	7. (d)	8. (a)	9. (c)	10. (a)
11. (c)	12. (d)	13. (a)	14. (a)	15. (b)	16. (d)	17. (a)	18. (a)	19. (c)	20. (b)
21. (d)	22. (d)	23. (d)	24. (b)	25. (c)	26. (a)	27. (c)	28. (a)	29. (a)	30. (d)
31. (a)	32. (a)	33. (d)	34. (d)	35. (b)	36. (d)	37. (a)	38. (a)	39. (d)	40. (d)
41. (a)	42. (d)	43. (a)	44. (b)	45. (a)	46. (a)	47. (a)	48. (d)	49. (b)	50. (d)
51. (c)	52. (a)	53. (a)	54. (b)	55. (a)	56. (d)	57. (d)	58. (d)	59. (c)	60. (a)
61. (d)	62. (d)	63. (c)	64. (d)	65. (d)	66. (d)	67. (b)	68. (c)	69. (c)	70. (a)
71. (a)	72. (a)	73. (a)	74. (a)	75. (a)	76. (d)	77. (c)	78. (d)	79. (b)	80. (a)
81. (c)	82. (d)	83. (a)	84. (c)	85. (d)	86. (d)	87. (b)	88. (b)	89. (b)	90. (c)
91. (d)	92. (b)	93. (b)	94. (d)	95. (d)	96. (b)	97. (c)	98. (a)	99. (d)	100. (a)
101. (c)	102. (b)	103. (c)	104. (b)	105. (b)	106. (c)	107. (c)			
111. (a)	112. (c)	113. (c)	114. (b)						

Explanations

1. (b) Amino acids exhibit ionizable properties due to their amine and carboxyl groups, leading to different structures at varying pH levels, and can exist in a zwitterionic form.

2. (d) Statement A and B are incorrect. Lecithin found in the plasma membrane is a phospholipid. Unsaturated fatty acids possess one or more C=C bonds.

3. (b) Lipids having only single bond are called saturated fatty acids and lipids having one or more C = C double bonds are called unsaturated fatty acids.
Palmitic acid has 16 carbon atoms. Arachidonic acid has 20 carbon atoms including the carboxyl carbon.
Lecithin is a phospholipid found in cell membrane.
Glycerol is a simple lipid which is trihydroxy propane.

4. (b) Lysine – Basic amino acid
Valine- Neutral amino acid
Glutamic acid- Acidic amino acid
Tyrosine- Aromatic amino acid

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5. **(a)** Glycine is an example of amino acids. It is the simplest amino acid with hydrogen as R-group.

6. **(b)** A typical fat molecule is made up of one glycerol (backbone of molecule) and three fatty acid molecules.

7. **(d)** A fat is formed of two kinds of molecules, i.e., glycerol and fatty acids. In making a fat, three fatty acid molecules each join to glycerol by an ester linkage. A fatty acid has a long carbon skeleton, usually 16 or 18 carbon atom in length. Fatty acids could be saturated or unsaturated.

8. **(a)** Lecithin is a phosphorylated glyceride found in cell membrane. Palmitic acid is a saturated fatty acid with 16 carbon atoms. Adenylic acid is the nucleotide consisting of adenine, sugar and a phosphate group. Alanine is a neutral amino acid.

9. **(c)** The structure (D) represents amino acid lysine. Their side chains contain nitrogen and resemble ammonia, which is a base.

10. **(a)** It is a phospholipid and is the component of cell membrane.

11. **(c)** 98% of living organisms are formed by six element carbon, hydrogen, nitrogen, oxygen, calcium and phosphorus.

12. **(d)** Carbon, hydrogen and oxygen mainly and mostly contributes to the dry weight of plants. These elements are most abundant in plants.

13. **(a)** Wood contains cellulose mixed with lignin. In paper industry, pulp prepared by extracting pure cellulose by removing lignin.

14. **(a)** Although required in small amounts, trace elements are vital for maintaining health. These trace elements are part of enzymes (as co-factor), hormones and cells in the body.

15. **(b)** Lipids are hydrophobic, i.e., non-polar. They don't interact with water and remain clumped together, apart from the water molecules.

16. **(d)** Erucic acid, is a monosaturated ω-9 (omega - nine) fatty acid. It is present in more concentration in oils and is easily degraded by micro-organisms and produces foul odour of oils. Thus, its presence is used to detect spoilage of oils.

17. **(a)** ATP or Adenosine Triphosphate is a nucleotide in which nitrogenous base, adenosine, is attached to ribose sugar bounded by three molecules of phosphate.

18. **(a)** Glycoproteins contain oligosaccharide chains covalently attached to polypeptide side chains.

19. **(c)** Carbon, hydrogen, oxygen and nitrogen are called four big elements of living body. They make up about 99% of the mass of most cells. These are lightest elements that are capable of forming covalent bonds. It is known that the strength of covalent bond is inversely related to the atomic weights of the bonded atoms. As C, H, O and N are lightest elements so the bonds they form are the strongest covalent bonds. So that the compounds formed are stable, varied in size and shapes. Carbon constitutes more than 50% of the dry matter. It has been observed that human body contains 0.5% hydrogen, 18.5% carbon, 65% oxygen and 3.3% nitrogen. Other elements are present in very lesser amount.

20. **(b)** Glycogen is a multibranched polysaccharide of glucose that serves as a form of energy storage.

21. **(d)** Up to 65-70% of human adult body is water. Brain & heart are composed of 73% water, and the lungs are about 83% water. Percentage of water in infants is 75-78%.

22. **(d)** Lecithin
Lecithin is not a secondary metabolite but a primary metabolite that forms a major component of phospholipid bilayer of cell membranes.

23. **(d)** A-(II), B-(IV), C-(I), D-(III)
(A) Terpenoides - (II) Diterpenes
(B) Lectins - (IV) Concanavalin A
(C) Alkaloids - (I) Codeine
(D) Toxins - (III) Ricin

24. **(b)**
A. Adenine - (IV) Purine
B. Anthocyanin - (I) Pigment
C. Chitin - (II) Polysaccha
D. Codeine - (III) Alkaloid

25. **(c)** Ricin and abrin are toxins. Vinblastin and curcumin are drugs.

26. **(a)** Amino acids, glucose are not secondary metabolites rather they are the examples of primary metabolites. Rest all other belongs to secondary metabolites.

27. **(c)** Concanavalin A, a secondary metabolite, is a lectin. It has the property to agglutinates RBCs.

28. **(a)** Inulin is used by plants as a means of storing energy. Pectin is a polysaccharide contained in the primary cell walls of terrestrial plants.

29. **(a)** Statement I is incorrect as the first amino acid is called as N-terminal amino acid and the last amino acid is called the C-terminal amino acid.

30. **(d)** Primary proteins are also called polypeptides because successive amino acids are joined by peptide bonds.

31. **(a)** Glycogen is a reserve food material in animals. Globulin is basically a group of simple soluble proteins in salt solution and forms a large fraction of blood serum protein. Gamma globulin consists of different types of antibodies like IgA, IgM etc. Steroids are a type of hormone. Thrombin is a biocatalyst.

32. **(a)** Collagen is the most abundant protein in animal world and RuBisCO is the most abundant protein in the whole biosphere.

33. **(d)** GLUT-IV is insulin-dependent transporter and is responsible for majority of glucose transport into muscle and adipose cells in anabolic conditions. Whereas GLUT-I is insulin independent and is widely distributed in different tissues.

34. **(d)**
- Nucleic acids are polymers of nucleotides
- Proteins are polymers of amino acids
- Polysaccharides are polymers of monosaccharides
- Lipids are the esters of fatty acids and alcohol

35. **(b)** Ester bonds is the least likely to be involved in stabilising the three–dimensional folding of most proteins.
The bond between the phosphate and hydroxyl group of sugar is an ester bond. As there is one such ester bond on either side, it is called phosphodiester bond.

36. **(d)** Collagen is the most abundant protein in animal world and Ribulose Bisphosphate Carboxylase-Oxygenase (RuBisCO) is the most abundant protein in the whole of the biosphere.

37. **(a)** Anaemia refers to any condition in which there is an abnormally low haemoglobin concentration. Deficiency of iron is the most common cause. So iron containing compounds in diet overcome these symptoms.

38. **(a)** Beriberi is caused due to deficiency of thiamine. It is due to excessive intake of polished rice. It results in weakness of muscles, slow reflexes, neuritis and progressive edema.

39. **(d)** Vitamin B_{12} is only found in animal foods & fortified foods. *Spirulina* and Cooked liver of lamb, veal, beef, goat are richest source of vitamin B_{12}.

40. **(d)** Vitamin A is a fat soluble vitamin that has a critical role in maintaining healthy eyes and skin. It is also a powerful antioxidant. Night blindness (Nyctalopia) is one of the signs of vitamin A deficiency.

41. **(a)** Vitamin B_6 is a water soluble vitamin that is found in many foods. Vitamin B_6 deficiency can cause symptoms including anxiety, depression, confusion, fatigue, muscle pains, worsening symptoms of anemia, etc. Its mild deficiency might have no symptoms for months or even years.

42. **(d)** Beri beri is a disease in which the body doesn't have enough vitamin B_1, also known as thiamine deficiency.

43. **(a)** Collagen is main structural, fibrous protein in extracellular space in various connective tissues in animal bodies, mostly in fibrous tissues such as tendons, ligaments and skin.

44. **(b)** Cellulose forms the cell walls of plants. Cellulose is the primary constituent of wood, making this one of the most abundant organic compound on the surface of the earth.

45. **(a)** Tocopherols are organic chemical compounds which have vitamin E activity.

46. **(a)** As an essential amino acid, phenylalanine is not synthesised *de novo* in humans and other animals who must ingest it. Other essential amino acids for humans are valine, threonine, tryptophan, methionine, leucine, isoleucine, lysine and histidine.

47. **(a)** α - helix is a common motif in the secondary structure of proteins and is a right hand-spiral conformation. These are the most common structural motif in membrane proteins & cholesterol-assisted oligomerisation of annular pore.

48. **(d)** RuBisCO (Ribulose - 1, 5 - bisphosphate) is the predominant protein in photosynthesising plant parts & most abundant protein on earth.

49. **(b)** Vitamin B complex includes thiamine, riboflavin, niacin, vitamin B_6, vitamin B_{12}, folic acid & pantothenic acid. Some also contains biotin or zinc.

50. **(d)** Beri beri is a disease in which body doesn't have enough vitamin B_1.

51. **(c)** Deficiency of folate or vitamin B_{12} inhibits purine and thymidylate synthesis, impairs DNA synthesis and causes erythroblast (RBCs) apoptosis, resulting in anaemia from ineffective erythropoiesis.

52. **(a)** Variations in proteins and their structure is largely due to the sequence in which 20 amino acids are arranged. The variation in sequence results in various interactions and thus various structure.

53. **(a)** Scurvy is a condition caused by a severe lack of vitamin C in the diet.

54. **(b)** Vitamin D is essential for strong bones because it helps the body use calcium from the diet.

55. **(a)** Niacin (nicotinic acid) is a vitamin that acts as a part of coenzymes (NAD, NADP) which serve as hydrogen acceptors and donors for many enzymes. Its deficiency in the body causes pellagra.

56. **(d)** α - ketoglutaric acid is an important biological compound. It is nitrogen - free portion of the amino acids known as glutamine and glutamic acid, which is catalysed by glutamate dehydrogenase for synthesis of non-essential amino acids in body.

57. **(d)** α-keto acids undergoes transamination reaction to form amino acids. In this reaction, an amino group is transferred to keto acid.

58. **(d)** Both starch and cellulose are made of glucose molecules, but the difference between them is that starch is branched polymer while cellulose is a linear polymer. Starch also forms helical secondary structures, so it can hold I_2 molecules in the helical portion. The Starch-I_2 is blue colour. Cellulose does not contain complex helices and hence cannot hold I_2.

59. **(c)** Protein - Peptide bonds
Unsaturated fatty acid - C=C double bonds
Nucleic acid - Phosphodiester bond
Polysaccharide - Glycosidic bonds

60. **(a)** Fructose
Inulin is a polysaccharide and a polymer of fructose.

61. **(d)** Exoskeleton of arthropods have a complex polysaccharide called chitin. Chitin is a long-chain polymer of N-acetylglucosamine, an amide derivative of glucose.

62. **(d)** Proteins are polypeptides. They are linear chains of amino acids linked by peptide bonds.
Unsaturated fatty acids contain one or more C = C double bonds.
In a nucleic acid a phosphate moiety links the 3'-carbon of one sugar of one nucleotide to the 5'-carbon of the sugar of the succeeding nucleotide. The bond between the phosphate and hydroxyl group of sugar is an ester bond. As there is one such ester bond on either side, it is called phosphodiester bond.
In a polysaccharide the individual monosaccharides are linked by a glycosidic bond. This bond is also formed by dehydration.

63. **(c)** Inulin is a polymer of fructose linked through glycosidic bonds.
Insulin is a protein composed of 51 amino acids. These amino acids are linked through peptide bonds.

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64. (d) Aquaporin – Polypeptide
Asparagine – Amide
Abscisic acid – Carotenoid
Chitin – Polysaccharide

65. (d) All carbohydrates (sugar) are characterised by carbonyl functional group (– C = O) along with a number of hydroxyl functional groups (C – OH). If carbonyl group is aldehyde, then sugar is called aldose, and if it is ketone, then sugar is known as ketose.

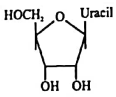
66. (d) The chemical formula of glycine: $NH_2–CH_2–COOH$, so glycine does not curtain sulphur in it.

67. (b) Chitin is a heteropolysaccharide found as structural component of arthropods exoskeleton. N-acetyl glucosamine is the basic unit, which are joined by (β-1 → 4) linkages.

68. (c) Backbone of DNA duplex is made up of sugar - phosphate which are joined by phosphodiester.

69. (c) Sucrose do not have free aldehydic group. Hence it does not reduce Tollen's reagent.

70. (a)



Uridine
Nucleoside

71. (a) In first couple of hours after the last meal, the body fuel is glucose then other carbohydrate sources such as stored glycogen starts to deplete. After this, body starts to metabolise fat to meet energy demands of body. As protein is the most essential compound of our body, it is given the last preference of being broken down to produce energy. During very long fasting, even muscle proteins starts to degrade.

72. (a) All monosaccharides (glucose, galactose, fructose) are reducing sugars because all of them have an aldehyde group or can tautomerise in solution to form an aldehyde group and act as a reducing agent.

73. (a) Chondroitin is a glycosaminoglycan composed of a chain of alternating sugars. It is usually found attached to proteins as a part of proteoglycan. It is a key building block of cartilage.

74. (a) Lactose is a disaccharide sugar composed of galactose and glucose.

75. (a) Cellulose is a polysaccharide consisting of a linear chain of thousands of β (1 - 4) linked D - glucose units.

76. (d) Glycogen, cellulose and starch are polysaccharides composed of several hundred to many thousand glucose units linked by glycosidic linkage.

77. (c) The most abundant and diverse molecules found in living cells are proteins. Proteins are macromolecules which perform a wide variety of functions in living cells.

78. (d) Adenine and guanine are purines found in all nucleic acids (i.e., RNA & DNA). In RNA, uracil is present as pyrimidine in place of thymine, which is found in DNA. Cytosine (a pyrimidine) is present in both DNA & RNA.

79. (b) Glycogen is a multibranched polysaccharide of glucose that serves as a form of energy storage in humans, animals, fungi and bacteria. In humans, glycogen is made & stored primarily in the cells of the liver and skeletal muscle.

80. (a) Thymine, cytosine and uracil are found under pyrimidines, whereas adenine and guanine are purines.

81. (c) In B-DNA, the length of each helix is 34Å and each helix contains approximately ten base pairs, thus, each base pair is 3.4Å apart.

82. (d) Three of the four nitrogenous bases that make up RNA - Adenine, guanine and cytosine - are also found in DNA. In RNA, however, uracil (U) replaces thymine (T) as complementary nucleotide to adenine.

83. (a) A purine is a heterocyclic aromatic ring that consists of a pyrimidine ring fused to an imidazole ring. Adenine and guanine are purines.

84. (c) Nucleotides are building blocks of nucleic acids; they are composed of 3 subunit molecules - a nitrogenous base, a 5-carbon sugar and phosphate group.

85. (d) DNA is a polymer of deoxyribonucleotides, i.e., in this 5-carbon sugar is 2'-deoxyribose.

86. (d) Nucleotides are building blocks of nucleic acids. In case of DNA, the sugar is deoxyribose, and in RNA, the sugar is ribose.

87. (b) RNA have uracil as a substituent of thymine. Thymine is absent in RNA, thus pairing occurs between adenine and uracil.

88. (b) The competitive inhibitor competes with the substrate for the substrate binding site of the enzyme. Consequently, the substrate cannot bind and as a result, the enzyme action declines, e.g. inhibition of succinic dehydrogenase by malonate which closely resembles the substrate succinate in structure. Such competitive inhibitors are often used in the control of bacterial pathogens.

89. (b) Both statements, I and II are correct. Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat. When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as competitive inhibitor. Due to its close structural similarity with the substrate, the inhibitor competes with the substrate for the substrate binding site of the enzyme. Consequently, the substrate cannot bind and as a result, the enzyme action declines, e.g., inhibition of succinic dehydrogenase by malonate which closely resembles the substrate succinate in structure.

90. (c) The prosthetic group for the enzyme catalysing the breakdown of hydrogen peroxide (H_2O_2) into water and oxygen is haem, which is part of the enzyme catalase.

91. (d) Ricin- Secondary metabolites
Malonate - Competitive inhibitor of catalytic activity of succinic dehydrogenase
Chitin- Present in the cell wall of fungi and exoskeleton of arthropods
Collagen- Proteinaceous in nature and possesses peptide bonds

92. (b) A coenzyme or metal ion that is tightly bound (covalently) to enzyme protein is called prosthetic group. A complete catalytic active enzyme with its bound prosthetic group is called holoenzyme.

93. (b) Non-protein constituents bound to the enzyme to make the enzyme active.
Apo-enzyme: protein portion of the enzyme
Holoenzyme = Co-factor + Apoenzyme
Co-factors are 3 types:
Prosthetic group: Organic and tightly bound to apoenzyme. E.g., in peroxidase and catalase, haem is prosthetic group.
Co-enzymes: Organic compounds which are loosely bound to apoenzyme. The essential component of many coenzymes is vitamins. E.g., NAD and NADP contain niacin.
Metal ions: They form co-ordination bonds with side chains at active site and at the same time form one or more co-ordination bonds with the substrate.

94. (d) In graph A, it represents exothermic reaction and reaction occur in presence of enzyme whereas B represents reaction in absence of enzyme.

95. (d) Almost all enzymes are proteins. There are some nucleic acids that behave like enzymes. These are called ribozymes.

96. (b) The effect of competitive inhibition on reaction is that substrate concentration needs to be increased to achieve a given reaction velocity, hence the K_m is increased.

97. (c) Addition of lot of succinate reverse the inhibition of succinic dehydrogenase by malonate. Malonate closely resembles the substrate succinate in structure.

98. (a) Co-enzymes are organic compounds which are loosely bound to apoenzyme. The essential component of many coenzymes is vitamins. E.g., NAD and NADP contain niacin.

99. (d) The transition state structure is transient and unstable.

100. (a) Zinc is a co-factor for carboxypeptidase enzyme.

101. (c) In the graph X-axis represents temperature and Y-axis, enzyme activity.

102. (b)

103. (c) Enzymes are proteinaceous in nature except ribozyme which is nucleic acid. They require optimum pH and temperature. They are highly specific

104. (b) Non-protein component of enzyme are called cofactor. It is of 3 types (Prosthetic, Coenzyme, & Metal ions). Coenzymes are organic compound which makes enzyme catalytically active.

105. (b) In non-competitive inhibition, the inhibitor combines reversibly with enzymes or enzyme substrate complex. This effect is not reversed by increasing substrate concentration. In competitive inhibition, inhibitor combines reversibly to the free enzyme at the active site. This effect is nullified by increasing substrate concentration.

106. (c) The lower the K_m, the higher is the substrate affinity of the enzymes.

107. (c) A ribonucleoprotein enzyme is essential for formation of telomere during cell division. It activates tumor suppressor gene. It leads to apoptosis (programmed cell death).

108. (c) Hydrolases are hydrolytic enzymes, that use water to cleave chemical bonds, usually dividing a large molecule into smaller molecules, e.g., esterases, proteases, lipases, glycosidases and nucleosidases.

109. (c) Feedback inhibition is the phenomenon where output of a process or end product is used as an input to control the behavior of process itself.

110. (a) Glycoproteins are a class of proteins which have carbohydrate groups attached to polypeptide chain.

111. (a) Enzymes are biological catalysts that increase the rate of chemical reactions within cells. Use of enzymes can lower the activation energy (E_a) of a reaction.

112. (c) A prosthetic group is a tightly - bound, specific, and non-protein unit required for biological function of some proteins. They may be organic (vitamin, sugar or lipid) or inorganic (metal ions) but are not composed of amino acids.

113. (c) Hexokinase, the enzyme, catalysing the first step of glycolysis, is inhibited by its product, glucose - 6 - phosphate. Thus, it is an example of feedback inhibition.

114. (b) Isoenzymes are enzymes that differ in amino acid sequence (or structure) but catalyse the same reaction. They have different K_m values as structures are different.

CHAPTER 10

Cell Cycle and Cell Division

Cell Cycle

1. Among eukaryotes, replication of DNA takes place in *(2023)*
   a. G_1 phase b. M phase
   c. S phase d. G_1 phase

2. Given below are two statements: **[MR*]** *(2023)*
   Statement I: During G_0 phase of cell cycle the cell is metabolically inactive.
   Statement II: The centrosome undergoes duplication during S phase of interphase.
   In the light of the above statements, choose the most appropriate answer from the option below:
   a. Statement I is incorrect but Statement II is correct
   b. Both Statement I and Statement II are correct
   c. Both Statement I and Statement II are incorrect.
   d. Statement I is correct but Statement II is incorrect.

3. Match List-I with List-II **[MR*]** *(2023)*

List-I		List-II	
(A)	M Phase	(I)	Proteins are synthesized
(B)	G_1 Phase	(II)	Inactive phase
(C)	Quiescent stage	(III)	Interval between mitosis and initiation of DNA replication
(D)	G_2 Phase	(IV)	Equational division

   Choose the correct answer from the options given below:
   a. A-II, B-IV, C-I, D-III b. A-III, B-II, C-IV, D-I
   c. A-IV, B-II, C-I, D-III d. A-IV, B-I, C-II, D-III

4. Which one of the following is the quiescent stage of cell cycle? *(2023-Manipur)*
   a. M b. G_2
   c. G_1 d. G_0

5. The fruit fly has 8 chromosomes (2n) in each cell. During interphase of Mitosis if the number of chromosomes at G_1 phase is 8, what would be the number of chromosomes after S phase? *(2021)*
   a. 16 b. 4
   c. 32 d. 8

6. The centriole undergoes duplication during: *(2021)*
   a. Prophase b. Metaphase
   c. G_2 phase d. S-phase

7. Match List - 1 with List - 2 *(2021)*

	List- 1		List - 2
A.	S phase	(i)	Proteins are synthesized
B.	G_2 phase	(ii)	Inactive phase
C.	Quiescent stage	(iii)	Interval between mitosis and initiation of DNA replication
D.	G_1 phase	(iv)	DNA replication

   Choose the correct answer from the options given below.
   a. A-iv B-ii C-iii D-i
   b. A-iv B-i C-ii D-iii
   c. A-ii B-iv C-iii D-i
   d. A-iii B-ii C-i D-iv

8. Identify the correct statement with regard to G_1 phase (Gap 1) of interphase. *(2020)*
   a. Reorganisation of all cell components takes place.
   b. Cell is metabolically active, grows but does not replicate its DNA.
   c. Nuclear division takes place.
   d. DNA synthesis or replication takes place.

9. Some dividing cells exit the cell cycle and enter vegetative inactive stage. This is called quiescent stage (G_0). This process occurs at the end of: *(2020)*
   a. G_1 phase b. S phase
   c. G_2 phase d. M phase

10. Match the following events that occur in their respective phases of cell cycle and select the correct option: *(2020-Covid)*

1.	G_1 phase	(i)	Cell grows and organelle duplication
2.	S phase	(ii)	DNA replication and chromosome duplication
3.	G_2 phase	(iii)	Cytoplasmic growth
4.	Metaphase in M-phase	(iv)	Alignment of chromosomes

    a. 1-(iii) 2-(iv) 3-(i) 4-(ii)
    b. 1-(iv) 2-(i) 3-(ii) 4-(iii)
    c. 1-(i) 2-(ii) 3-(iii) 4-(iv)
    d. 1-(ii) 2-(iii) 3-(iv) 4-(i)

11. The correct sequence of phases of cell cycle is *(2019)*
    a. $M \rightarrow G_1 \rightarrow G_2 \rightarrow S$ b. $G_1 \rightarrow G_2 \rightarrow S \rightarrow M$
    c. $S \rightarrow G_1 \rightarrow G_2 \rightarrow M$ d. $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$

12. Cell in G_0 phase *(2019)*
    a. Exit the cell cycle b. Enter the cell cycle
    c. Suspend the cell cycle d. Terminate the cell cycle

13. DNA replication in bacteria occurs: *(2017-Delhi)*
    a. During S-phase b. Within nucleolus
    c. Prior to fission d. Just before transcription

14. When cell has stalled DNA replication fork, which checkpoint should be predominantly activated? **[OS]** *(2016 - II)*
    a. M b. Both G_2/M and M
    c. G_1/S d. G_2/M

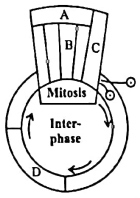
15. During cell growth, DNA synthesis takes place in: *(2016 - II)*
    a. G_2 phase b. M phase
    c. S phase d. G_1 phase

16. A somatic cell that has just completed the S phase of its cell cycle, as compared to gamete of the same species, has: **[MR*]** *(2015 Re)*
    a. Twice the number of chromosomes and four times the amount of DNA
    b. Four times the number of chromosomes and twice the amount of DNA
    c. Twice the number of chromosomes and twice the amount of DNA
    d. Same number of chromosomes but twice the amount of DNA

17. During which phase(s) of cell cycle, amount of DNA in a cell remains at 4C level if the initial amount is denoted as 2C? *(2014)*
    a. G_2 and M b. G_0 and G_1
    c. G_1 and S d. Only G_2

18. In 'S' phase of the cell cycle: *(2014)*
    a. Amount of DNA is reduced to half in each cell
    b. Amount of DNA doubles in each cell
    c. Amount of DNA remains same in each cell
    d. Chromosome number is increased

19. Given below is schematic break-up of phases of cell cycle. Which one is correct matching? *(2009)*



    a. A – Cytokinesis b. B – Metaphase
    c. C – Karyokinesis d. D – Synthetic phase

20. In the somatic cell cycle: *(2004)*
    a. DNA replication takes place in S-phase
    b. A short interphase is followed by a long mitotic phase
    c. G_2 phase follows mitotic phase
    d. In G_1 phase DNA content is double the amount of DNA present in the original cell

21. Spindle fibre unite with which structure of chromosomes? *(2000)*
    a. Chromocentre b. Chromomere
    c. Kinetochore d. Centriole

22. In which stage of cell cycle, DNA replication occurs? *(2000)*
    a. G_1 - phase b. S - phase
    c. G_2 - phase d. M - phase

23. Amount of cellular DNA increases during: *(1999)*
    a. Cytokinesis b. Fertilisation
    c. Mutation d. Respiration

24. In S-phase, DNA is replicated in a medium containing radioactive thymidine, radioactivity will be observed in: *(1998)*
    a. Euchromatin b. Heterochromatin
    c. Both (a) & (b) d. Nucleolus

25. Which typical stage is known for DNA replication? *(1996)*
    a. S-phase b. G_2- phase
    c. Metaphase d. G_1-phase

26. In a somatic cell cycle, DNA synthesis takes place in: *(1994)*
    a. G_1 phase b. Prophase of mitosis
    c. S-phase d. G_2 phase

Mitosis

27. Doubling of the number of chromosomes can be achieved by disrupting mitotic cell division soon after: *(2023-Manipur)*
    a. Anaphase b. Telophase
    c. Prophase d. Metaphase

28. With respect to metaphase, which of the following statements is incorrect? *(2022 Re)*
    a. Chromosomes lie at the equator of the cell
    b. Complete disintegration of nuclear envelope takes place
    c. Chromosomes are highly condensed
    d. Metaphase chromosomes are made up of four sister chromatids held together by centromere

29. Which one of the following never occurs during mitotic cell division? *(2022)*
    a. Coiling and condensation of the chromatids
    b. Spindle fibres attach to kinetochores of chromosomes
    c. Movement of centrioles towards opposite poles
    d. Pairing of homologous chromosomes

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30. Select the incorrect statement with reference to mitosis: *(2022)*

a. Splitting of centromere occurs at anaphase.
b. All the chromosomes lie at the equator at metaphase.
c. Spindle fibres attach to centromere of chromosomes.
d. Chromosomes decondense at telophase.

31. In a mitotic cycle, the correct sequence of phases is *(2020-Covid)*

a. G_1, S, G_2, M
b. M, G_1, G_2, S
c. G_1, G_2, S, M
d. S, G_1, G_2, M

32. Attachment of spindle fibers to kinetochores of chromosomes becomes evident in : *(2020-Covid)*

a. Telophase
b. Prophase
c. Metaphase
d. Anaphase

33. Which of the following options gives the correct sequence of events during mitosis? *(2017-Delhi)*

a. Condensation → Nuclear membrane disassembly → Crossing over → Segregation → Telophase
b. Condensation → Nuclear membrane disassembly → Arrangement at equator → Centromere division → Segregation → Telophase
c. Condensation → Crossing over → Nuclear membrane disassembly → Segregation → Telophase
d. Condensation → Arrangement at equator → Centromere division → Segregation → Telophase

34. Anaphase promoting complex (APC) is a protein degradation machinery necessary for proper mitosis of animal cells. If APC is defective in a human cell, which of the following is expected to occur? **[OS]** *(2017-Delhi)*

a. Chromosomes will not condense
b. Chromosomes will be fragmented
c. Chromosomes will not segregate
d. Recombination of chromosome arms will occur

35. Which of the following is not a characteristic feature during mitosis in somatic cells? *(2016 - I)*

a. Spindle fibres
b. Disappearance of nucleolus
c. Chromosome movement
d. Synapsis

36. Spindle fibres attach on to: *(2016 - I)*

a. Telomere of the chromosome
b. Kinetochore of the chromosome
c. Centromere of the chromosome
d. Kinetosome of the chromosome

37. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in: *(2016 - I)*

a. Aneuploidy
b. Polyploidy
c. Somaclonal variation
d. Polyteny

38. A stage in cell division is shown in the figure. Select the answer which gives correct identification of the stage with its characteristics: *(2013)*

a.	Telophase	Endoplasmic reticulum and nucleolus not reformed yet.
b.	Telophase	Nuclear envelope reforms, Golgi complex reforms
c.	Late Anaphase	Chromosomes move away from equatorial plate, Golgi complex not present.
d.	Cytokinesis	Cell plate formed, mitochondria distributed between two daughter cells.

39. At metaphase, chromosomes are attached to the spindle fibres by their: *(2011 Mains)*

a. Kinetochores
b. Centromere
c. Satellites
d. Secondary constrictions

40. Select the correct option with respect to mitosis: *(2011 Pre)*

a. Chromosomes move to the spindle equator and get aligned along equatorial plate in metaphase.
b. Chromatids separate but remain in the center of the cell in anaphase.
c. Chromatids start moving towards opposite poles in telophase.
d. Golgi complex and endoplasmic reticulum are still visible at the end of prophase.

41. During mitosis ER and nucleolus begin to disappear at: *(2010 Pre)*

a. Early metaphase
b. Late metaphase
c. Early prophase
d. Late prophase

42. Which stages of cell division do the following figure A and B represent respectively? *(2010 Pre)*

A

B

a. Telophase – Metaphase
b. Late Anaphase – Prophase
c. Prophase – Anaphase
d. Metaphase – Telophase

43. Which one of the following preceeds re-formation of the nuclear envelope during M phase of the cell cycle? **[OS]** *(2004)*

a. Transcription from chromosomes and reassembly of the nuclear lamina
b. Formation of the contractile ring and formation of the phragmoplast
c. Formation of the contractile ring and transcription from chromosomes
d. Decondensation from chromosomes and reassembly of the nuclear lamina

44. If you are provided with root-tips of onion in your class and are asked to count the chromosomes which of the following stages can you most conveniently look into? **[OS]** *(2004)*

a. Telophase
b. Anaphase
c. Prophase
d. Metaphase

45. Mitotic spindle is mainly composed of which protein? *(2002)*

a. Actin
b. Myosin
c. Actomyosin
d. Myoglobin

46. Best material for the study of mitosis in laboratory: *(2002)*

a. Anther
b. Root tip
c. Leaf tip
d. Ovary

47. If a diploid cell is treated with colchicine then it becomes: **[OS]** *(2002)*

a. Triploid
b. Tetraploid
c. Diploid
d. Monoploid

48. How many mitotic divisions are needed for a single cell to make 128 cells? *(1997)*

a. 28
b. 32
c. 7
d. 14

49. During cell division in apical meristem, the nuclear membrane appears in: *(1996)*

a. Telophase
b. Cytokinesis
c. Metaphase
d. Anaphase

50. Colchicine is an inhibitory chemical, which: **[OS]** *(1996)*

a. Stops the functioning of centriole
b. Prevents attaching of centromeres with rays
c. Prevents the spindle formation in mitosis
d. Prevents the formation of equatorial plane

51. Which of the following represents the best stage to view the shape, size and number of chromosomes? *(1994)*

a. Prophase
b. Metaphase
c. Interphase
d. Telophase

52. Number of chromatids at metaphase is: *(1992)*

a. Two each in mitosis and meiosis
b. Two in mitosis and one in meiosis
c. Two in mitosis and four in meiosis
d. One in mitosis and two in meiosis

53. Mitotic anaphase differs from metaphase in possessing: *(1991)*

a. Same number of chromosomes and same number of chromatids
b. Half number of chromosomes and half number of chromatids
c. Half number of chromosomes and same number of chromatids
d. Same number of chromosomes and half number of chromatids

Meiosis

54. Which of the following stages of meiosis involves division of centromere? *(2023)*

a. Telophase
b. Metaphase I
c. Metaphase II
d. Anaphase II

55. The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis? *(2023)*

a. Diakinesis
b. Pachytene
c. Zygotene
d. Diplotene

56. Select the correct statements. **[MR*]** *(2023)*

A. Tetrad formation is seen during leptotene.
B. During Anaphase, the centromere split and chromatids separate.
C. Terminalization takes place during Pachytene.
D. Nucleolus, Golgi complex and ER are reformed during Telophase.
E. Crossing over takes place between sister chromatids of homologous chromosome

Choose the correct answer from the option given below:

a. B and E only
b. A and C only
c. B and D only
d. A, C and E only

57. The dissolution of synaptonemal complex occurs during: *(2023-Manipur)*

a. Pachytene
b. Diplotene
c. Diakinesis
d. Leptotene

58. During which stages of mitosis and meiosis, respectively does the centromere of each chromosome split? *(2023-Manipur)*

a. Metaphase, Metaphase II
b. Prophase, Telophase I
c. Telophase, Anaphase I
d. Anaphase, Anaphase II

59. Select correct sequence of substages of Prophase-I of Meiotic division: *(2023-Manipur)*

(A) Zygotene
(B) Pachytene
(C) Diakinesis
(D) Leptotene
(E) Diplotene

Choose the correct answer from the options given below:

a. (D), (B), (A), (E), (C)
b. (A), (B), (D), (E), (C)
c. (D), (A), (B), (E), (C)
d. (A), (D), (B), (C), (E)

60. Which stage of meiosis can last for months or years in the oocytes of some vertebrates? *(2022 Re)*

a. Diakinesis
b. Leptotene
c. Pachytene
d. Diplotene

61. In meiosis, crossing over and exchange of material between homologous chromosomes catalyzed by the enzyme: *(2022 Re)*

a. Polymerase
b. Phosphorylase
c. Recombinase
d. Transferase

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62. Identify the correct sequence of events during Prophase I of meiosis: *(2022 Re)*

A. Synapsis of homologous chromosomes
B. Chromosomes become gradually visible under microscope
C. Crossing over between non-sister chromatids of homologous chromosomes
D. Terminalisation of chiasmata
E. Dissolution of synaptonemal complex

Choose the correct answer from the options given below:

a. (A), (C), (D), (E), (B) b. (A), (B), (C), (D), (E)
c. (B), (C), (D), (E), (A) d. (B), (A), (C), (E), (D)

63. Bivalent or Tetrad formation is a characteristic feature observed during: *(2022 Re)*

a. Chiasmata in zygotene stage
b. Synaptonemal complex in zygotene stage
c. Chiasmata in Diplotene stage
d. Synaptonemal complex in Pachytene stage

64. The appearance of recombination nodules on homologous chromosomes during meiosis characterizes *(2022)*

a. Terminalization
b. Synaptonemal complex
c. Bivalent
d. Sites at which crossing over occurs

65. Regarding Meiosis, which of the statements is incorrect? *(2022)*

a. Four haploid cells are formed at the end of Meiosis-II
b. There are two stages in Meiosis, Meiosis-I and II
c. DNA replication occurs in S phase of Meiosis-II
d. Pairing of homologous chromosomes and recombination occurs in Meiosis-I

66. Which stage of meiotic prophase shows terminalisation of chiasmata as its distinctive feature? *(2021)*

a. Zygotene b. Diakinesis
c. Pachytene d. Leptotene

67. Which of the following stages of meiosis involves division of centromere? *(2021)*

a. Metaphase II b. Anaphase II
c. Telophase II d. Metaphase I

68. Match the following with respect to meiosis: *(2020)*

	Column-I		Column-II
1.	Zygotene	(i)	Terminalization
2.	Pachytene	(ii)	Chiasmata
3.	Diplotene	(iii)	Crossing over
4.	Diakinesis	(iv)	Synapsis

Select the correct option from the following:

(1) (2) (3) (4)
a. (iv) (iii) (ii) (i)
b. (i) (ii) (iv) (iii)
c. (ii) (iv) (iii) (i)
d. (iii) (iv) (i) (ii)

69. Dissolution of the synaptonemal complex occurs during *(2020)*

a. Zygotene b. Diplotene
b. Leptotene d. Pachytene

70. During Meiosis I, in which stage synapsis takes place? *(2020-Covid)*

a. Zygotene b. Diplotene
c. Leptotene d. Pachytene

71. The stage during which separation of the paired homologous chromosomes begins is *(2018)*

a. Pachytene b. Diplotene
c. Diakinesis d. Zygotene

72. Match the stages of meiosis in Column–I to their characteristic features in Column–II and select the correct option using the codes given below: **[MR*]** *(2016 - II)*

	Column I		Column II
A.	Pachytene	i.	Pairing of homologous chromosomes
B.	Metaphase-I	ii.	Terminalisation of chiasmata
C.	Diakinesis	iii.	Crossing over takes place
D.	Zygotene	iv.	Chromosomes align at equatorial plate

Codes:

a. A-ii B-iv C-iii D-i
b. A-iv B-iii C-ii D-i
c. A-iii B-iv C-ii D-i
d. A-i B-iv C-ii D-iii

73. In meiosis, crossing over is initiated at: *(2016 - I)*

a. Pachytene b. Leptotene
c. Zygotene d. Diplotene

74. Select the correct option: **[MR*]** *(2015)*

	Column-I		Column-II
A.	Synapsis aligns the homologous chromosomes	i.	Anaphase-II
B.	Synthesis of RNA and protein	ii.	Zygotene
C.	Action of enzyme recombinase	iii.	G_2-phase
D.	Centromeres do not separate but chromatids move towards opposite poles	iv.	Anaphase-I
		v.	Pachytene

a. A-i B-ii C-iii D-iv
b. A-ii B-iii C-iv D-v
c. A-ii B-i C-iii D-iv
d. A-ii B-iii C-v D-iv

75. Arrange the following events of meiosis in correct sequence: *(2015 Re)*

A. Crossing over
B. Synapsis
C. Terminalisation of chiasmata
D. Disappearance of nucleolus

a. (B), (A), (C), (D) b. (A), (B), (C), (D)
c. (B), (C), (D), (A) d. (B), (A), (D), (C)

76. The enzyme recombinase is required at which stage of meiosis? *(2014)*

a. Diakinesis b. Pachytene
c. Zygotene d. Diplotene

77. The complex formed by a pair of synapsed homologous chromosomes is called: *(2013)*

a. Axoneme b. Equatorial plate
c. Kinetochores d. Bivalent

78. Given below is the representation of a certain event at a particular stage of a type of cell division. Which is this stage? *(2012 Pre)*

a. Both prophase and metaphase of mitosis
b. Prophase I during meiosis
c. Prophase II during meiosis
d. Prophase of Mitosis

79. Identify the meiotic stage in which the homologous chromosomes separate while the sister chromatids remain associated at their centromeres: *(2012 Mains)*

a. Metaphase I b. Metaphase II
c. Anaphase I d. Anaphase II

80. During gamete formation, the enzyme recombinase participates during: *(2012 Pre)*

a. Prophase-II b. Metaphase-I
c. Anaphase-II d. Prophase-I

81. Synapsis occurs between: *(2009)*

a. Spindle fibres and centromeres
b. mRNA and ribosome
c. A male and female gamete
d. Two homologous chromosomes

82. Crossing over that results in genetic recombination in higher organisms occurs between: *(2004)*

a. Non-sister chromatids of a bivalent
b. Two daughter nuclei
c. Two different bivalents
d. Sister chromatids of a bivalents

83. What occurs in crossing over? *(1998)*

a. Recombination b. Independent assortment
c. Mutation d. None

84. When paternal and maternal chromosomes change their materials with each other in cell division this event is called: *(1996)*

a. Bivalent-forming b. Dyad-forming
c. Synapsis d. Crossing-over

85. Which statement best explains the evolutionary advantage of meiosis? *(1994)*

a. Meiosis is necessary for sexual reproduction
b. Genetic recombinations are possible from generation to generation
c. Meiosis alternates with mitosis from generation to generation
d. The same genetic system is passed on from generation to generation

86. Meiosis II performs: *(1993)*

a. Separation of sex chromosomes
b. Synthesis of DNA and centromere
c. Separation of homologous chromosomes
d. Separation of chromatids

87. In meiosis, the daughter cells differ from parent cell as well as amongst themselves due to: *(1991)*

a. Segregation, independent assortment and crossing over
b. Segregation and crossing over
c. Independent assortment and crossing over
d. Segregation and independent assortment

88. A bivalent consists of: *(1989)*

a. Two chromatids and one centromere
b. Two chromatids and two centromeres
c. Four chromatids and two centromeres
d. Four chromatids and four centromeres

89. Meiosis I is reductional division. Meiosis II is equational division due to: *(1988)*

a. Pairing of homologous chromosomes
b. Crossing over
c. Separation of chromatids
d. Disjunction of homologous chromosomes

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Answer Key

1. (c)	2. (a)	3. (d)	4. (d)	5. (d)	6. (d)	7. (b)	8. (b)	9. (a)	10. (c)
11. (d)	12. (a)	13. (c)	14. (c)	15. (c)	16. (a)	17. (d)	18. (b)	19. (d)	20. (a)
21. (c)	22. (b)	23. (b)	24. (c)	25. (a)	26. (c)	27. (d)	28. (d)	29. (d)	30. (c)
31. (a)	32. (c)	33. (b)	34. (c)	35. (d)	36. (b)	37. (b)	38. (b)	39. (a)	40. (a)
41. (d)	42. (b)	43. (b)	44. (d)	45. (none)	46. (b)	47. (b)	48. (c)	49. (a)	50. (c)
51. (b)	52. (a)	53. (d)	54. (d)	55. (b)	56. (c)	57. (b)	58. (d)	59. (c)	60. (d)
61. (c)	62. (d)	63. (b)	64. (d)	65. (c)	66. (b)	67. (b)	68. (a)	69. (b)	70. (a)
71. (b)	72. (c)	73. (a)	74. (d)	75. (a)	76. (b)	77. (d)	78. (b)	79. (c)	80. (d)
81. (d)	82. (a)	83. (a)	84. (d)	85. (b)	86. (d)	87. (a)	88. (c)	89. (c)	

Explanations

1. **(c)** In eukaryotes, S or Synthesis phase marks the period during which DNA synthesis or replication takes place. During this phase the amount of DNA per cell doubles.

2. **(a)** The cells that do not divide further exit G_1 phase to enter an inactive stage called quiescent stage (G_0) of the cell cycle. Cells in this stage remain metabolically active but no longer proliferate unless called on to do so depending on the requirement of organism.

3. **(d)** M phase is most dramatic period of cell cycle also called equatioeal division.

   G_2 phase: Proteins are synthesized in preparation for mitosis.

   Quiescent stage: cell do not divide further exit G_1 phase to enter an inactive state.

   G_1 phase: This phase corresponds to the interval between mitosis and initiation of DNA replication.

4. **(d)** G_0

   The G_0 phase is a quiescent stage where cells exit the cell cycle and do not divide.

5. **(d)** In S phase or synthesis phase, DNA replication takes place so the amount of DNA becomes double but the chromosome number remains same. Thus, if the number of chromosomes at G_1 phase is 8 in fruit fly then the number of chromosomes will be same in S phase and after S phase, i.e., 8 chromosomes.

6. **(d)** During S phase of interphase, the centriole undergoes duplication.

   During prophase, condensation of chromatin starts.

   In G_2 phase, synthesis of proteins occurs.

   During metaphase, chromosomes get aligned at equator to form metaphasic plate.

7. **(b)** DNA replication takes place at S phase.

   Proteins are synthesized at G_2 phase.

   Quiescent stage is considered as an inactive phase.

   G_1 Phase is the interval between mitosis and initiation of DNA replication.

8. **(b)** During G_1 phase continuously grows.

   synthesis phase marks the period during which DNA synthesis or replication takes place. Reorganisation of all cell components takes place in M-Phase.

9. **(a)** Some dividing cells exit the cell cycle and enter vegetative inactive stage, called quiescent stage (G_0). This process occurs during the G_1 phase. Therefore, most appropriate option is G_1 phase.

10. **(c)** G_1 phase – Cytoplasmic growth

    S phase – Only DNA replication takes place, the chromosome number remains same.

    G_2 phase – Cell grows and organelle duplication

    Metaphase in M-phase – Alignment of chromosomes

    Note: The events given in the question are not exactly matched with the respective phases of the cell cycle, however the most appropriate answer is (c).

11. **(d)** The correct sequence of phases of cell cycle is

    $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$

12. **(a)** Cells in G_0 phase are said to exit cell cycle. These are at quiescent stage and do not proliferate unless called upon to do so but they remain metabolically active.

13. **(c)** DNA replication in bacteria occurs prior to fission. Prokaryotes do not show well marked S-phase due to their primitive nature.

14. **(c)** G_2/S checkpoint controls the transition of eukaryotic cells from G_2 phase to S phase. When cell has stalled DNA replication fork, G_2/S checkpoint should be predominantly activated.

15. **(c)** S or synthesis phase marks the period during which DNA synthesis or replication takes place. During this time, the amount of DNA per cell doubles.

16. **(a)**

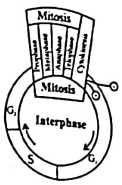
	Gamete	Somatic cell
Ploidy	n	2n
DNA	c	4c

17. **(d)**

	Ploidy level	Amount of DNA
G_1	2n	2C
S	2n	4C
G_2	2n	4C
M	2n	2C

18. **(b)** 'S' phase marks the period during which DNA synthesis or replication takes place. Amount of DNA per cell doubles.

19. **(d)**



20. **(a)** S phase, also called synthesis phase, is the part of cell cycle in which DNA is replicated occuring between G_1 phase & G_2 phase.

21. **(c)** Kinetochore is a complex of proteins associated with the centromere of a chromosome during cell division, to which the microtubules of the spindle attach.

22. **(b)** In a eukaryotic cell cycle, DNA duplication occurs during S-phase.

23. **(b)** During meiosis, cells that are destined to become gametes have half the number of chromosomes, but union of two gametes during fertilisation results in offspring (a new cell) with twice the chromosomes gametes had. Therefore, amount of cellular DNA increases during the process of fertilisation.

24. **(c)** When cells are grown in the presence of radioactive thymidine, it is incorporated into DNA during S phase. Hence, euchromatin and heterochromatin both will show radioactivity.

25. **(a)** The S-phase is the period of DNA replication.

26. **(c)** During S-phase, chromosomes enter a relaxed state that allows enzyme DNA polymerase to replicate the DNA double helix.

27. **(d)** Metaphase

    Doubling of chromosome numbers can be achieved by disrupting mitotic cell division soon after metaphase, which prevents the separation of duplicated chromosomes.

28. **(d)** Metaphase chromosomes consist of two sister chromatids held together by a centromere.

29. **(d)** Pairing of homologous chromosomes is called synapsis. It takes place in zygotene stage of prophase-I of meiosis-I.

    Prophase, metaphase, anaphase and telophase are the four stages of mitotic cell division. Chromosome condensation occurs during prophase. Simultaneously, the centrioles move to the opposite poles. During metaphase, spindle fibres attach to kinetochores of chromosomes.

30. **(c)** Small disc-shaped structures at the surface of the centromeres are called kinetochores. These structures serve as the sites of attachment of spindle fibres. During metaphase stage, spindle fibres attach to kinetochores of chromosomes.

31. **(a)** The cell progresses through defined phases of the cell cycle during its division. It is divided into two phases. The M Phase represents the phase when the actual cell division or mitosis occurs and the interphase represents the phase between two successive M phases. Interphase is divided into three phases: G_1 (first gap), S (synthesis), and G_2 (second gap). The correct sequence of the phases of a cell cycle is $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$.

32. **(c)** Metaphase is characterised by all the chromosomes coming to lie at the equator with one chromatid of each chromosome connected by its kinetochore to spindle fibres from one pole and its sister chromatid connected by its kinetochore to spindle fibres from the opposite pole.

33. **(b)** The correct sequence of events during mitosis would be as follows:
    (i) Condensation of DNA so that chromosomes become visible occurs during early to mid-prophase.
    (ii) Nuclear membrane disassembly begins at mid prophase.
    (iii) Arrangement of chromosomes at equator occurs during metaphase, called congression.
    (iv) Centromere division or splitting occurs during anaphase forming daughter chromosomes.
    (v) Segregation also occurs during anaphase as daughter chromosomes separate and move to opposite poles.
    (vi) Telophase leads to formation of two daughter nuclei.

34. **(c)** Anaphase Promoting Complex (APC) is a protein necessary for separation of daughter chromosomes during anaphase. If APC is defective then the chromosomes will fail to segregate during anaphase.

35. **(d)** In somatic cells, only mitosis takes place. But in germ cells, meiosis take place. During zygotene stage of meiosis I, chromosomes start pairing together and this process of association is called synapsis.

36. **(b)** Spindle fibres attach on to kinetochore of the chromosome.

37. **(b)** Failure of cytokinesis after telophase stage of cell division results in an increase in a whole set of chromosomes in an organism and this phenomenon is known as polyploidy. This condition is often seen in plants.

38. **(b)** The figure in the question shows telophase. In telophase, nucleolus, nuclear envelope, Golgi complex and ER reform.

39. **(a)** At metaphase, chromosomes are attached to the spindle fibres by their kinetochores (A protein structure present on chromatids).

40. **(a)** Chromosomes move to the spindle equator and get aligned along equatorial plate in metaphase during mitosis.

41. **(d)** Cells at the end of prophase, when viewed under microscope do not show Golgi complexes, endoplasmic reticulum, nucleolus and the nuclear envelope.

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42. (b) A - Late Anaphase, B - Prophase

43. (b) A cell in two nuclei are formed during M-phase of cell cycle, formation of contractile ring takes place in animal cell and formation of phragmoplast takes place in plant cell to initiate cytokinesis and then membrane around nucleus reforms, cellular organelles reassemble, etc.

44. (d) Metaphase is the second stage of M phase, during which the chromosomes get attached to spindle fibres and are at the most condensed stage. In this phase, chromosomes align themselves at middle of the cell and are completely condensed thus can be easily counted.

45. (None) The mitotic spindle is a structure composed of microtubules, mainly tubulins, which segregates chromosomes during mitosis.

46. (b) A root tip is a rapidly growing part of the plant and thus many cells will be in different stage of mitosis.

47. (b) Colchicine inhibits microtubule polymerisation and effectively functions as a mitotic poison. It is, therefore, widely used in plant breeding for doubling the chromosome number.

48. (c) Mitosis is an equational division where after division each cell produces two daughter cells, therefore, after 7 divisions one cell will give 128 cells in case of mitosis.

$1 \xrightarrow{1} 2 \xrightarrow{2} 4 \xrightarrow{3} 8 \xrightarrow{4} 16 \xrightarrow{5} 32 \xrightarrow{6} 64 \xrightarrow{7} 128$

49. (a) Telophase is the final stage in karyokinesis. During telophase, the nuclear envelope reforms around new nuclei, and mitotic spindle disappears. The nucleolus also reappears.

50. (c) Colchicine inhibits microtubule polymerisation by binding to tubulin. Availability of tubulin is essential to mitosis, so colchicine effectively functions as a mitotic or spindle poison.

51. (b) During metaphase, the chromosomes guided by spindle fibres line up in the middle of the dividing cell. It is defined as the point at which all of the chromosomes are fully condensed and therefore, it is the best stage to count and study chromosomes.

52. (a) During metaphase, the number of chromatids is double the number of chromosomes.

53. (d) During anaphase, the sister-chromatids of a chromosome starts to separate thus reducing the number of chromatids but the number of chromosomes tend to be same.

54. (d) Anaphase II stage of meiosis II is characterised by the following key events:

1. Centromeres split and chromatids separate.
2. Chromatids move to opposite poles.

55. (b) The first two stages of prophase I are relatively short-lived compared to the next stage that is pachytene. During this stage the four chromatids of each bivalent chromosomes become distinct and clearly appears as tetrads. This stage is characterized by the appearance of recombination nodules, the site at which crossing over occurs between non-sister chromatids of the homologous chromosomes.

56. (c) Tetrad formation is seen during zygotene. The last stage of meiotic prophase I is diakinesis. This is marked by terminalisation of chiasmata. Crossing over occurs between non-sister chromatids of the homologous chromosomes.

57. (b) The dissolution of the synaptonemal complex occurs during the Diplotene stage of meiosis, where homologous chromosomes start to separate, except at the sites of crossovers called chiasmata.

58. (d) Anaphase, Anaphase II

The centromere of each chromosome splits during Anaphase of mitosis and Anaphase II of meiosis.

59. (c) (D) (A) (B) (E) (C)

The correct sequence of substages in Prophase I of Meiosis is Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis.

60. (d) In the oocytes of some vertebrates, the diplotene stage of meiosis can last for months or even years.

61. (c) Recombinase is the enzyme that catalyses crossing over and exchange of genetic material between homologous chromosomes during meiosis.

62. (d) The events during Prophase I of meiosis:

Chromatin condenses into visible chromosomes

Homologous chromosomes pair up in synapsis.

Crossing over happens between non-sister chromatids of homologous chromosomes.

Synaptonemal complex dissolves, leading to homologous chromosome separation.

Terminalisation of chiasmata

63. (b) Bivalent or tetrad formation is characteristic of the synaptonemal complex in the zygotene stage of meiosis.

64. (d) The pachytene stage of prophase I of meiosis I is characterised by the appearance of recombination nodules. These are the sites at which crossing over occurs between non-sister chromatids of the homologous chromosomes.

65. (c) S phase of a cell cycle occurs during interphase, before mitosis or meiosis, and is responsible for the synthesis or replication of DNA.

66. (b) Diakinesis is the final stage of meiotic prophase I and is marked by terminalisation of chiasmata.

Leptotene is the first stage of meiotic prophase I and in this stage, the chromosomes become gradually visible under the light microscope.

Zygotene is the second stage of prophase I and this stage is characterised by synapsis.

Pachytene is the third stage of meiotic prophase I and this stage is characterised by the appearance of recombination nodules.

67. (b) In Anaphase II, simultaneous splitting of centromere of each chromosome takes place due to which they move to opposite poles.

In Metaphase II, the chromosomes align at the equator and the spindle fibres get attached to the kinetochores of sister chromatids.

Telophase II is a stage which marks the end of meiosis where the chromosomes once again get enclosed by a nuclear envelope.

Metaphase I is a stage in which bivalent chromosomes align on the equatorial plate.

68. (a) Zygotene - Synapsis

Pachytene - Crossing over

Diplotene - Chiasmata formation

Diakinesis – Terminalisation of chiasmata

69. (b) Diplotene stage is characterized by the dissolution of the synaptonemal complex, and X-shaped structures called chiasmata.

70. (a) Zygotene is the second stage of prophase I of meiosis I. During this stage, chromosomes start pairing together and this process of association is called synapsis. Such paired chromosomes are called homologous chromosomes.

71. (b) Diplotene is the 4th stage of prophase I in meiosis, during which the paired chromosomes begin to separate due to the dissolution of the synaptonemal complex.

72. (c) Pachytene: Crossing over is the exchange of genetic material between non-sister chromatids of two homologous chromosomes with the help of an enzyme, recombinase.

Metaphase-I: Chromosomes align at equatorial plate

Diakinesis: Terminalisation of chiasmata.

Zygotene: Homologous chromosomes start pairing together (synapsis) with the help of a complex structure called synaptonemal complex.

73. (a) Crossing over is the exchange of genetic material between two non-sister chromatids of the homologous chromosomes. Crossing over is also an enzyme-mediated process and the enzyme involved is called recombinase. Crossing over occurs in pachytene stage of meiosis I.

74. (d) Zygotene: synapsis aligns the homologous chromosomes

G_2-phase: Synthesis of RNA and proteins.

Pachytene : Action of enzyme recombinase

Anaphase I : Centromeres do not separate but chromatids move towards opposite poles.

75. (a) Zygotene - Synapsis

Pachytene - Crossing over

Diakinesis - Chiasmata Terminalisation

End of diakinesis - Disappearance of nucleolus

76. (b) Crossing over is an enzyme-mediated process and recombinase enzyme is involved in this. This occurs in pachytene.

77. (d) Bivalents or tetrads refers to paired homologous chromosomes in zygotene stage.

78. (b) Prophase I during meiosis: Prophase of the first meiotic division is typically longer and more complex when compared to prophase of mitosis. It has been further subdivided into the following five phases based on chromosomal behavior, i.e., leptotene, zygotene, pachytene, diplotene and diakinesis.

79. (c) During anaphase I, the homologous chromosomes separate, while sister chromatids remain associated at their centromeres.

80. (d) During prophase-I of meiosis (Pachytene): Crossing over occurs (the exchange of genetic material between two homologous chromosomes). Crossing over is also an enzyme-mediated process and the enzyme involved is called recombinase.

81. (d) Pairing of homologous chromosomes (maternal and paternal) is called synapsis. It occurs in zygotene of prophase I of meiotic division.

82. (a) Chromosomal crossover is exchange of genetic material between homologous chromosomes. It involves the recombination between non-sister chromatids during the production of gametes.

83. (a) Recombination occurs when two molecules of DNA exchange pieces of their genetic material with each other, as in crossing over.

84. (d) Crossing over is the genetic exchange between non-sister chromatids of homologous chromosomes during meiosis, which results in new allelic combinations in the daughter cells.

85. (b) During crossing over of meiosis, exchange of genetic material takes place between non-sister chromatids of homologous chromosomes and result in genetic recombination. In every generation, this recombination occurs at the time of gamete formation.

86. (d) In meiosis I, the chromosomes number is reduced to half but in meiosis II, number of chromosomes remain the same. During meiosis II, two chromatids of a replicated chromosome separate.

87. (a) Due to crossing over, daughter cells are different from their parent cell. Also, segregated chromosomes (product of crossing over) are independently assorted in two nuclei resulting in formation of different daughter cells.

88. (c) Bivalent or tetrad is the complex formed by a pair of synapsed homologous chromosomes or four chromatids physically held together by two centromeres.

89. (c) Meiosis I is reductional division as the chromosome number reduce to half of the parent cell but meiosis II is an equational division, like mitosis, as after anaphase chromosome number does not reduce and only chromatids are separated.

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CHAPTER 11

Photosynthesis in Higher Plants

Experiments of Photosynthesis

1. Anoxygenic photosynthesis is characteristic of: [OS] *(2014)*
   a. *Ulva* b. *Rhodospirillum*
   c. *Spirogyra* d. *Chlamydomonas*

2. A photosynthesising plant is releasing ^{18}O more than the normal. The plant must have been supplied with: *(1993)*
   a. O_2 b. H_2O with ^{18}O
   c. CO_2 with ^{18}O d. $C_6H_{12}O_6$ with ^{18}O

3. Maximum solar energy is trapped by: [OS] *(1993)*
   a. Planting trees b. Cultivating crops
   c. Growing algae in tanks d. Growing grasses

Location & Pigments of Photosynthesis

4. Match List-I with List-II. *(2023-Manipur)*

List-I		List-II	
(A)	Chlorophyll *a*	(I)	Yellow to yellow orange
(B)	Chlorophyll *b*	(II)	Yellow green
(C)	Xanthophyll	(III)	Blue green
(D)	Carotenoid	(IV)	Yellow

Choose the **correct** answer from the options given below:
   a. A-III, B-II, C-IV, D-I b. A-III, B-I, C-IV, D-II
   c. A-II, B-III, C-I, D-IV d. A-IV, B-III, C-II, D-I

5. Which of the following statements is incorrect? [MR*] *(2021)*
   a. Stroma lamellae have PS I only and lack NADP reductase.
   b. Grana lamellae have both PS I and PS II.
   c. Cyclic photophosphorylation involves both PS I and PS II.
   d. Both ATP and NADPH + H^+ are synthesized during non-cyclic photophosphorylation.

6. Phytochrome is a: *(2016 - I)*
   a. Lipoprotein b. Chromoprotein
   c. Flavoprotein d. Glycoprotein

7. In a chloroplast the highest number of protons are found in: *(2016 - I)*
   a. Stroma b. Lumen of thylakoid
   c. Inter membranal space d. Antennae complex

8. Water soluble pigments found in plant cell vacuoles are: *(2016 - I)*
   a. Xanthophylls b. Chlorophylls
   c. Carotenoids d. Anthocyanins

9. Emerson's enhancement effect and Red drop have been instrumental in the discovery of: [OS] *(2016 - I)*
   a. Photophosphorylation and non-cyclic electron transpon
   b. Two photosystem operating simultaneously
   c. Photophosphorylation and cyclic electron transport
   d. Oxidative phosphorylation

10. In photosynthesis, the light-independent reactions take place at: *(2015 Re)*
    a. Photosystem-I b. Photosystem-II
    c. Stromal matrix d. Thylakoid lumen

11. Chloroplast stroma of higher plants contains: *(2009)*
    a. Chlorophyll
    b. Light dependent reaction enzymes
    c. Light independent reaction enzymes
    d. Lysosomes

12. P_r state of phytochrome absorbs light wavelength of: [OS] *(2007)*
    a. 660 nm b. 640 nm
    c. 620 nm d. 720 nm

13. Photosynthetically active radiation (PAR) represents the following range of wave length: *(2004)*
    a. 450–950 nm b. 340–450 nm
    c. 400–700 nm d. 500–600 nm

14. Which fractions of the visible spectrum of solar radiations are primarily absorbed by carotenoids of the higher plants? [OS] *(2003)*
    a. Blue and green b. Green and red
    c. Red and violet d. Violet and blue

15. Which pigment absorbs the red and far-red light? [OS] *(2002)*
    a. Cytochrome b. Phytochrome
    c. Carotenoids d. Chlorophyll

16. Which pigment system inactivated in red drop? [OS] *(2001)*
    a. PS-I and PS-II b. PS – I
    c. PS–II d. None

17. Proteinaceous pigment which control the activities concerned with light: *(2001)*
    a. Phytochrome b. Chlorophyll
    c. Anthocyanin d. Carotenoids

18. Chlorophyll-*a* molecule at its carbon atom 3 of the pyrrole ring II has one of the following: *(1997)*
    a. Carboxylic group b. Magnesium
    c. Aldehyde group d. Methyl group

19. The core metal of chlorophyll is: *(1997)*
    a. Ni b. Cu
    c. Fe d. Mg

20. A pigment which absorbs red and far-red light is: [OS] *(1997)*
    a. Cytochrome b. Xanthophyll
    c. Phytochrome d. Carotene

21. What will be the effect on phytochrome in a plant subjected to continuous red light? *(1997)*
    a. Phytochrome synthesis will increase
    b. Level of phytochrome will decrease
    c. Phytochrome will be destroyed
    d. First (b) then (a)

22. Which of the following pigments acts as a reaction-centre during photosynthesis? *(1994)*
    a. Carotene b. Phytochrome
    c. P_{700} d. Cytochrome

23. Chlorophyll *a* occurs in: *(1992)*
    a. All photosynthetic autotrophs
    b. In all higher plants
    c. All oxygen liberating autotrophs
    d. All plants except fungi

24. Photosynthetic pigments found in the chloroplasts occur in: *(1991)*
    a. Thylakoid membranes b. Plastoglobules
    c. Matrix d. Chloroplast envelope

25. The size of chlorophyll molecule is: [OS] *(1989)*
    a. Head 15 × 15Å, tail 25Å
    b. Head 20 × 20Å, tail 25Å
    c. Head 15 × 15Å, tail 20Å
    d. Head 10 × 12Å, tail 25Å

Light Reaction & Electron Transport

26. The reaction centre in PS II has an absorption maxima at *(2023)*
    a. 780 nm b. 680 nm
    c. 700 nm d. 660 nm

27. Which of the following combinations is required for chemiosmosis? [MR*] *(2023)*
    a. proton pump, electron gradient, NADP synthase
    b. membrane, proton pump, proton gradient, ATP synthase
    c. membrane, proton pump, proton gradient, NADP synthase
    d. proton pump, electron gradient, ATP synthase

28. Which out of the following statements is incorrect? *(2023-Manipur)*
    a. Grana lamellae have both PS I and PS II
    b. Cyclic photophosphorylation involves both PS I and PS II
    c. Both ATP and NADPH + H^+ are synthesised during non-cyclic photophosphorylation
    d. Stroma lamellae lack PS II and NADP reductase

29. Identify the correct statements regarding chemiosmotic hypothesis [MR*] *(2022 Re)*
    A. Splitting of the water molecule takes place on the inner side of the membrane.
    B. Protons accumulate within the lumen of the thylakoids.
    C. Primary acceptor of electron transfers the electrons to an electron carrier.
    D. NADP reductase enzyme is located on the stroma side of the membrane.
    E. Protons increase in number in stroma.
    Choose the correct answer from the options given below:
    a. (B), (C) and (E) b. (A), (B) and (E)
    c. (A), (B) and (D) d. (B), (C) and (D)

30. Which one of the following is **not true** regarding the release of energy during ATP synthesis through chemiosmosis? It involves: *(2022)*
    a. Reduction of NADP to $NADPH_2$ on the stroma side of the membrane
    b. Breakdown of proton gradient
    c. Breakdown of electron gradient
    d. Movement of protons across the membrane to the stroma

31. In light reaction, plastoquinone facilitates the transfer of electrons from: *(2020)*
    a. $Cytb_6f$ complex to PS-I b. PS-I to $NADP^+$
    c. PS-I to ATP synthase d. PS-II to $Cytb_6f$ complex

32. During non-cyclic photophosphorylation, when electrons are lost from the reaction centre at PS II, what is the source which replaces these electrons? *(2020-Covid)*
    a. Water b. Carbon dioxide
    c. Light d. Oxygen

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33. Read the following four statements (A - D)
A. Both, photophosphorylation and oxidative phosphorylation involve uphill transport of protons across the membrane
B. In dicot stem, a new cambium originates from cells of pericycle at the time of secondary growth
C. Sclereids in flowers of Guava and Pyrenes are polyandrous
D. Symbiotic nitrogen-fixers occur in free-living state also as well
How many of the above statements are right? *(2012 Mains)*
a. Two b. Three
c. Four d. One

34. Read the following four statements A, B, C and D and select the right option having both correct statements: *(2010 Mains)*
A. Z-Scheme of light reaction takes place in presence of PSI only
B. Only PSI is functional in cyclic photophosphorylation
C. Cyclic photophosphorylation results into synthesis of ATP and NADPH
D. Stroma lamellae lack PSII as well as NADP
a. B and D b. A and B
c. B and C d. C and D

35. Chemiosmotic coupling hypothesis of oxidative phosphorylation proposes ATP synthesis because of: *(2005)*
a. Proton gradient forms across inner membrane
b. Changed impermeability of inner mitochondrial membrane to ADP
c. High energy bonds are formed in mitochondrial proteins
d. ADP is pumped out of the matrix into Intermembrane space

36. In photosystem I, the first electron acceptor is: *(2006)*
a. Fe-S protein b. Ferredoxin
c. Cytochromes d. Plastocyanin

37. Chemiosmotic theory of ATP synthesis in chloroplasts and mitochondria is based on: *(2005)*
a. Membrane potential
b. Accumulation of Na^+ ions
c. Accumulation of K^+ ions
d. Proton gradient

38. Which one of the following concerns photophosphorylation? *(2003)*
a. ADP + AMP $\xrightarrow{\text{Light energy}}$ ATP
b. ADP + Inorganic PO_4 $\xrightarrow{\text{Light energy}}$ ATP
c. ADP + Inorganic PO_4 $\longrightarrow$ ATP
d. AMP + Inorganic PO_4 $\xrightarrow{\text{Light energy}}$ ATP

39. In photosynthesis, energy from light reaction to dark reaction is transferred in the form of: *(2002)*
a. ADP b. ATP
c. $PaHP$ d. Chlorophyll

40. Which of the following absorb light energy for photosynthesis? *(2002)*
a. Chlorophyll b. Water molecule
c. O_2 d. RuBP

41. Cytochrome is: *(2001)*
a. Metallo-flavo protein
b. Fe containing porphyrin pigment
c. Glycoprotein
d. Lipid

42. The first step for initiation of photosynthesis will be: *(2001)*
a. Photolysis of water
b. Excitement of chlorophyll molecule due to absorption of light
c. ATP formation
d. Glucose formation

43. What happens in light reaction (photo-chemical reaction)? *(2000)*
a. Formation of ATP and $NADPH_2$
b. Formation of ATP
c. Formation of sugar
d. Breakdown of sugar

44. Which is wrong for cytochrome P_{450}? *(1998)*
a. It contains Fe b. It concerned with oxidation
c. It is a pigment d. It is a coloured cell

45. $NADPH_2$ is generated through: *(1997)*
a. Photosystem II b. Anaerobic respiration
c. Glycolysis d. Photosystem I

46. The mechanism of ATP formation both in chloroplast and mitochondria is explained by: [OS] *(1997)*
a. Chemiosmotic theory
b. Munch's hypothesis (mass flow model)
c. Relay pump theory of Godlewski
d. Cholodny-Went's model

47. During light reaction of photosynthesis, which of the following phenomenon is observed during cyclic phosphorylation as well as non-cyclic phosphorylation? *(1994)*
a. Release of O_2
b. Formation of ATP
c. Formation of NADPH
d. Involvement of PS I and PS II pigment systems

48. Photosystem II occurs in: *(1992)*
a. Stroma b. Cytochrome
c. Grana d. Mitochondrial surface

49. Ferredoxin is a constituent of: *(1991)*
a. PS I b. PS II
c. Hill reaction d. P_{680}

50. Dark reactions of photosynthesis occur in: *(1991)*
a. Granal thylakoid membranes
b. Stromal lamella membranes
c. Stroma outside photosynthetic lamellae
d. Periplastidial space

51. NADP is reduced to NADPH in: *(1988)*
a. PS I
b. PS II
c. Calvin cycle
d. Noncyclic photophosphorylation

52. Carbon dioxide joins the photosynthetic pathway in: *(1988)*
a. PS I b. PS II
c. Light reaction d. Dark reaction

Where are ATP & NADPH Used?

53. How many ATP and NADPH, are required for the synthesis of one molecule of Glucose during Calvin cycle? *(2023)*
a. 18 ATP and 16 $NADPH_2$
b. 12 ATP and 12 $NADPH_2$
c. 18 ATP and 12 $NADPH_2$
d. 12 ATP and 16 $NADPH_2$

54. When one CO_2 molecule is fixed as one molecule of triose phosphate, which of the following photochemically made, high energy chemical intermediates are used in the reduction phase? *(2022 Re)*
a. 2 ATP + 2 NADPH b. 1 ATP + 1 NADPH
c. 1 ATP + 2 NADPH d. 2 ATP + 1 NADPH

55. Which of the following is not a product of light reaction of photosynthesis? *(2018)*
a. ATP b. NADH
c. NADPH d. Oxygen

56. PGA as the first CO_2 fixation product was discovered in photosynthesis of: *(2010)*
a. Gymnosperms b. Angiosperms
c. Alga d. Bryophytes

57. In C_3 plants, the first stable product of photosynthesis during the dark reaction is: *(2004)*
a. Oxaloacetic acid b. 3-phosphoglyceric acid
c. Phosphoglyceraldehyde d. Malic acid

58. Glycolate induces opening of stomata in: *(2001)*
a. Presence of oxygen b. Low CO_2 concentration
c. High CO_2 d. CO_2 absent

59. For the synthesis of one glucose molecule, the Calvin cycle operates for: *(2000)*
a. 2 times b. 4 times
c. 6 times d. 8 times

60. For assimilation of one CO_2 molecule; the energy required in form of ATP & $NADPH_2$: *(2000)*
a. 2 ATP & 2 $NADPH_2$ b. 5 ATP & 3 $NADPH_2$
c. 3 ATP & 2 $NADPH_2$ d. 18 ATP & 12 $NADPH_2$

61. What will for the number of Calvin cycles to generate one molecule of hexose? *(1996)*
a. 8 b. 9
c. 4 d. 6

62. The primary acceptor, during CO_2 fixation in C_3 plants, is: *(1996)*
a. Phosphoenolpyruvate (PEP)
b. Ribulose 1 5-biphosphate (RuBP)
c. Phosphoglyceric acid (PGA)
d. Ribulose monophosphate (RMP)

63. The carbon dioxide acceptor in Calvin cycle C_3-plants is: *(1993)*
a. Phospho-enol pyruvate (PEP)
b. Ribulose 1, 5, biphosphate (RuBP)
c. Phosphoglyceric acid (PGA)
d. Ribulose monophosphate (RMP)

64. Which technique has helped in investigation of Calvin cycle? *(1991)*
a. X-ray crystallography
b. X-ray technique
c. Radioactive isotope technique
d. Intermittent light

C_4 Pathway & Photorespiration

65. Given below are two statements: [MR] *(2023-Manipur)*
Statement I: RuBisCO is the most abundant enzyme in the world.
Statement II: Photorespiration does not occur in C_4 plants.
In the light of the above statements, choose the **most appropriate** answer from the options given below:
a. **Statement I** is correct but **Statement II** is incorrect
b. **Statement I** is incorrect but **Statement II** is correct
c. Both **Statement I** and **Statement II** are correct
d. Both **Statement I** and **Statement II** are incorrect

66. What is the role of large bundle sheath cells found around the vascular bundles in C_4 plants? *(2022)*
a. To protect the vascular tissue from high light intensity
b. To provide the site for photorespiratory pathway
c. To increase the number of chloroplast for the operation of Calvin cycle
d. To enable the plant to tolerate high temperature

67. Given below are two statements: *(2022)*
Statement I: The primary CO_2 acceptor in C_4 plants is phosphoenolpyruvate and is found in the mesophyll cells.
Statement II: Mesophyll cells of C_4 plants lack RuBisCO enzyme
In the light of the above statements, choose the correct answer from the options given below
a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both statement I and statement II are incorrect
d. Statement I is correct but Statement II is incorrect

68. The first stable product of CO_2 fixation in *Sorghum* is: *(2021)*
a. Oxaloacetic acid b. Succinic acid
c. Phosphoglyceric acid d. Pyruvic acid

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69. The oxygenation activity of RuBisCO enzyme in photorespiration leads to the formation of: *(2020)*
a. 1 molecule of 3-C compound
b. 1 molecule of 6-C compound
c. 1 molecule of 4-C compound and 1 molecule of 2-C compound
d. 2 molecules of 3-C compound

70. Which of the following statements is incorrect? [MR*] *(2020-Covid)*
a. In C_4 plants, the site of RuBisCO activity is mesophyll cell
b. The substrate molecule for RuBisCO activity is a 5-carbon compound
c. RuBisCO action requires ATP and NADPH
d. RuBisCO is a bifunctional enzyme

71. Phosphoenol pyruvate (PEP) is the primary CO_2 acceptor in: *(2017-Delhi)*
a. C_3 plants b. C_4 plants
d. C_2 plants d. C_3 and C_4 plants

72. The process which makes major difference between C_3 and C_4 plants is: *(2016 - II)*
a. Photorespirntion b. Respiration
c. Glycolysis d. Calvin cycle

73. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In which of the following physiological groups would you assign this plant? *(2016 - I)*
a. C_3 b. C_4
c. CAM d. Nitrogen fixer

74. Which one of the following organisms is correctly matched with its three characteristics? [MR*] *(2012 Mains)*
a. Pea: C_3 pathway, Endospermic seed, Vexillary aestivation
b. Tomato: Twisted aestivation, Axile placentation, Berry
c. Onion: Bulb, Imbricate aestivation, Axile placentation
d. Maize: C_3 pathway, closed vascular bundles, Scutellum

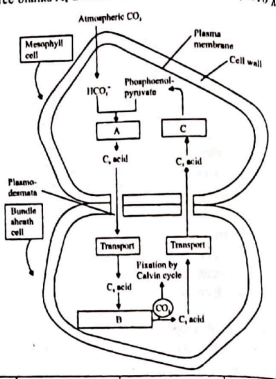
75. A process that makes important difference between C_3 and C_4 plants is: *(2012 Pre)*
a. Photorespiration b. Transpiration
c. Glycolysis d. Photosynthesis

76. The correct sequence of cell organelles during photo respiration is: *(2012 Pre)*
a. Chloroplast, vacuole, peroxisome
b. Chloroplast, Golgi bodies, mitochondria
c. Chloroplast, Rough Endoplasmic reticulum, Dictyosomes
d. Chloroplast, mitochondria, peroxisome

77. In Kranz anatomy, the bundle sheath cells have: *(2011 Mains)*
a. Thin walls, no intercellular spaces and several chloroplasts
b. Thick walls, many intercellular spaces and few chloroplasts
c. Thin walls, many intercellular spaces and no chloroplasts
d. Thick walls, no intercellular spaces and large number of chloroplasts

78. CAM helps the plants in: *(2011 Pre)*
a. Reproduction b. Conserving water
c. Secondary growth d. Disease resistance

79. Study the pathway given below:
In which of the following options correct words for all three blanks A, B and C are indicated: *(2010 Mains)*



	A	B	C
a.	Decarboxylation	Reduction	Regeneration
b.	Fixation	Transamination	Regeneration
c.	Fixation	Decarboxylation	Regeneration
d.	Carboxylation	Decarboxylation	Reduction

80. C_4 plants are photosynthetically more efficient than C_3 plants because: *(2008)*
a. CO_2 efflux is not prevented
b. They have more chloroplasts
c. CO_2 compensation point is more
d. CO_2 generated during photorespiration is recycled through PEP carboxylases

81. Malic acid is formed in C_4 plants in the cells of: *(2007)*
a. Epidermis b. Bundle sheath
c. Phloem d. Mesophyll

82. During photorespiration oxygen consuming reaction(s) occur in: *(2006)*
a. Stroma of chloroplasts
b. Stroma of chloroplasts and mitochondria
c. Stroma of chloroplast and peroxisomes
d. Grana of chloroplasts and peroxisomes

83. Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 because: *(2005)*
a. Effective pumping of CO_2 into bundle sheath cells
b. RuBisCO in C_4 plants has higher affinity for CO_2
c. Four carbon acids are primary initial CO_2 fixation products
d. Primary fixation of CO_2 is mediated via PEP carboxylase

84. Which one of the following is wrong in relation to photorespiration? *(2003)*
a. It occurs in chloroplasts
b. It occurs in daytime only
c. It is a characteristic of C_4 plants
d. It is a characteristic of C_3 plants

85. Stomata of CAM plants: *(2003)*
a. Are always open
b. Open during the day and close at night
c. Open during the night and close during the day
d. Never open

86. In sugarcane plant $^{14}CO_2$ is fixed in malic acid, in which the enzyme that fixes CO_2 is: *(2003)*
a. Ribulose biphosphate carboxylase
b. Phosphoenol pyruvic acid carboxylase
c. Ribulose phosphate kinase
d. Fructose phosphatase

87. Which pair is wrong? *(2001)*
a. C_3 – Maize b. C_4 – Kranz anatomy
c. Calvin cycle – PGA d. Hatch and slack cycle – OAA

88. Which is the first CO_2 acceptor enzyme in C_4 plants? *(2000)*
a. RuBP Carboxylase b. Phosphoric acid
c. RuBisCO d. PEP- Carboxylase

89. Photorespiration is favoured by: *(1996)*
a. High temperature and low O_2
b. High humidity and temperature
c. High O_2 and low CO_2
d. High CO_2 and low O_2

90. In C_4 plants, CO_2 combines with: *(1996)*
a. Phosphoenol pyruvate b. Phosphoglyceraldehyde
c. Phosphoglyceric acid d. Ribulose diphosphate

91. In C_4 plants, CO_2 fixation is done by: *(1996)*
a. Sclerenchyma
b. Chlorenchyma and hypodermis
c. Mesophyll cells
d. Guard cells

92. The CO_2 fixation during C_4 pathway occurs in the chloroplast of: *(1995)*
a. Guard cells b. Bundle sheath cells
c. Mesophyll cells d. Spongy parenchyma

93. Which one is a C_4-plant? *(1993)*
a. Papaya b. Pea
c. Potato d. Maize/corn

94. The enzyme that catalyses carbon dioxide fixation in C_4 plants is: *(1992)*
a. RuBP carboxylase b. PEP carboxylase
c. Carbonic anhydrase d. Carboxydismutase

95. The first carbon dioxide acceptor in C_4-plants is: *(1992, 1990)*
a. Phosphoenol-pyruvate b. Ribulose 1, 5-diphosphate
c. Oxalo-acetic acid d. Phosphoglyceric acid

96. Kranz anatomy is typical of: *(1990)*
a. C_4 plants b. C_3 plants
c. C_2 plants d. CAM plants

97. The substrate for photorespiration is: *(1989)*
a. Phosphoglyceric acid b. Glycolate
c. Serine d. Glycine

98. In C_4 plants, Calvin cycle operates in: *(1989)*
a. Stroma of bundle sheath chloroplasts
b. Grana of bundle sheath chloroplasts
c. Grana of mesophyll chloroplasts
d. Stroma of mesophyll chloroplasts

Factors Affecting Photosynthesis

99. With reference to factors affecting the rate of photosynthesis, which of the following statements is **not** correct? [MR*] *(2017-Delhi)*
a. Light saturation for CO_2 fixation occurs at 10% of full sunlight
b. Increasing atmospheric CO_2 concentration upto 0.05% can enhance CO_2 fixation rate
c. C_3 plants responds to higher temperatures with enhanced photosynthesis while C_4 plants have much lower temperature optimum
d. Tomato is a greenhouse crop which can be grown in CO_2 - enriched atmosphere for higher yield

100. Plants adapted to low light intensity have: *(2004)*
a. Higher rate of CO_2 fixation than the sun plants
b. More extended root system
c. Leaves modified to spines
d. Larger photosynthetic unit size than the sun plants

101. Maximum photosynthesis takes place by: [OS] *(1999)*
a. Phytoplankton b. Zooplankton
c. Marsh plants d. Woody plants

102. 'The law of limiting factors' was proposed by: [OS] *(1996)*
a. Leibig b. Hatch and Slack
c. Blackman d. Arnon

103. At a temperature above 35°C: *(1992)*
a. Rate of photosynthesis will decline earlier than that or respiration
b. Rate of respiration will decline earlier than that of photosynthesis
c. There is no fixed pattern
d. Both decline simultaneously

104. During monsoon, the rice crop of eastern states of India shows lesser yield due to limiting factor of: [OS] *(1991)*
a. CO_2 b. Light
c. Temperature d. Water

105. A very efficient converter of solar energy with net productivity of 20-4 kg/m² or more is the crop: *(1989)*
a. Wheat b. Sugarcane
c. Rice d. Bajra

NEET PQFs

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Answer Key

1. (b)	2. (b)	3. (c)	4. (a)	5. (c)	6. (b)	7. (b)	8. (d)	9. (b)	10. (c)
11. (c)	12. (a)	13. (c)	14. (d)	15. (b)	16. (c)	17. (a)	18. (d)	19. (d)	20. (c)
21. (d)	22. (c)	23. (c)	24. (a)	25. (c)	26. (b)	27. (b)	28. (b)	29. (c)	30. (c)
31. (d)	32. (a)	33. (a)	34. (a)	35. (a)	36. (a)	37. (d)	38. (b)	39. (b)	40. (a)
41. (b)	42. (b)	43. (a)	44. (d)	45. (d)	46. (a)	47. (b)	48. (c)	49. (a)	50. (c)
51. (d)	52. (d)	53. (c)	54. (a)	55. (b)	56. (c)	57. (b)	58. (b)	59. (c)	60. (c)
61. (d)	62. (b)	63. (b)	64. (c)	65. (c)	66. (c)	67. (b)	68. (a)	69. (a)	70. (a)
71. (b)	72. (a)	73. (b)	74. (b)	75. (a)	76. (d)	77. (d)	78. (b)	79. (c)	80. (b)
81. (d)	82. (c)	83. (d)	84. (c)	85. (c)	86. (b)	87. (a)	88. (d)	89. (c)	90. (a)
91. (c)	92. (c)	93. (d)	94. (b)	95. (a)	96. (a)	97. (b)	98. (a)	99. (c)	100. (d)
101. (a)	102. (c)	103. (a)	104. (b)	105. (b)					

Explanations

1. (b) *Rhodospirillum* use H_2S as the source of hydrogen other than H_2O. So, O_2 is not released in photosynthesis.

2. (b) The plant must have been supplied with H_2O with ^{18}O.

3. (c) Maximum solar energy is trapped by growing algae. The light spectrum of red & blue light are most effective in performing photosynthesis for growing algae.

4. (a)

(A) Chlorophyll *a* - (III) Blue green

(B) Chlorophyll *b*- (II) Yellow green

(C) Xanthophyll - (IV) Yellow

(D) Carotenoid - (I) Yellow to yellow orange

5. (c) Cyclic photophosphorylation involves only PS I whereas non-cyclic photophosphorylation involves both PS I and PS II.

6. (b) Phytochrome is a chromoprotein.

7. (b) In a chloroplast the highest number of protons are found in lumen of thylakoid.

Within the chloroplast, protons in the stroma decrease in number, while in the lumen of thylakoid there is accumulation of protons. This creates a proton gradient across the thylakoid membrane as well as a measurable decrease in pH in the lumen.

8. (d) Water soluble pigments found in plant cell vacuoles are anthocyanins.

9. (b) Emerson's enhancement effect (1957) and Red drop have been instrumental in the discovery of two photosystem operating simultaneously.

Emerson performed this experiment on *Chlorella*.

10. (c) In stroma, enzymatic reactions incorporate CO_2 into the plant leading to the sugar synthesis. These reactions are not directly light driven but are dependent on the products of light reactions (ATP and NADPH).

11. (c) Stroma is the site of dark reactions. While grana of thylakoid is the site of light reactions.

12. (a) Phytochrome is a chromoprotein. It exists in two state, blue and yellow green, P_r and P_{fr}. P_r or P_{660} absorbs light a 660 nm.

13. (c) Photosynthetically Active Radiation (PAR) is the light wavelength range that is best fit for photosynthesis to occur. Photosynthesis optimally occurs in 400-700 nanometer range.

14. (d) Carotenoids absorb light in the blue-green and violet region and reflect the longer yellow, red and orange wavelengths.

15. (b) Phytochromes are characterised by a red or far-red photochromicity, i.e., (660-730nm).

16. (c) Photosystem - II absorbs light maximally at 680 nm and red drop is inactivated in this photosystem.

17. (a) Phytochrome is a blue-green pigment found in plants. It regulates various developmental processes in those plants, such as photoperiodic induction of flowering.

18. (d) To each pyrrole ring of chlorophyll, a methyl group is attached.

19. (d) Chlorophyll binds magnesium at the center of the tetrapyrrole ring.

20. (c) Phytochrome is a pigment that allows the plant to absorb red and far-red light.

21. (d) Phytochromes are a class of photoreceptor that plants use to detect light. They are sensitive to light in the red region of visible spectrum.

22. (c) In PS I, the reaction centre chlorophyll *a* has an absorption peak at 700 nm, hence is called P_{700}.

23. (c) Chlorophyll *'a'* is a specific form of chlorophyll used in oxygenic photosynthesis. It is found in all oxygen releasing autotrophs.

24. (a) The green pigment chlorophyll, which is important for photosynthesis, is located within the thylakoid membranes of chloroplast.

25. (c) Chlorophyll are the magnesium porphyrin (head, 15 Å, 15 Å) compounds. A long chain of C atoms called as phytol (tail, 20 Å) is attached to porphyrin ring.

26. (b) In PS I the reaction centre chlorophyll *a* has an absorption peak at 700 nm, hence is called P_{700} while in PS II it has absorption maxima at 680 nm, and is called P_{680}.

27. (b) Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase.

Energy is used to pump protons across a membrane, to create a gradient or a high concentration of protons within the thylakoid lumen. ATP synthase has a channel that allows diffusion of protons back across the membrane; this releases enough energy to activate ATP synthase enzyme that catalyses the formation of ATP.

28. (b) Cyclic photophosphorylation involves both PS I and PS II.

In cyclic photophosphorylation, only Photosystem I (PS I) is involved, and it does not require Photosystem II (PS II). During cyclic photophosphorylation, electrons are recycled within PS I, and ATP is produced without the generation of NADPH.

29. (c) According to the chemiosmotic hypothesis, the splitting of water molecules occurs on the inner side of the thylakoid membrane, protons accumulate within the lumen of the thylakoids, and the NADP reductase enzyme, which is involved in the transfer of electrons to $NADP^+$, is located on the stroma side of the membrane.

30. (c) Photosystem - II absorbs light maximally at 680 nm and red drop is inactivated in this photosystem.

31. (d) The pathway of electron transfer in the light reaction is as follows:

PS –II → Pheophytin (primary electron acceptor) → Plastoquinone → Cyt b_6f complex → Plastocyanin → PS I → Phylloquinone → Ferredoxin

32. (a) During non-cyclic photophosphorylation, the electrons that were lost from photosystem II must be replaced. This is achieved by electrons available due to splitting of water. Photosystem II splits molecules of H_2O into $1/2\ O_2$, $2H^+$, and 2 electrons. These electrons continuously replace the electrons being lost by Photosystem II antenna complexes.

33. (a) Statements A and C are correct.

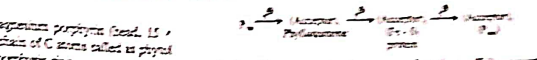
Symbiotic nitrogen fixers occur in association with the plant. They are not available in free-living state in soil. New cambium originates from secondary cortex or phelloderm.

Petunia → A_3, *Gloriosa* → A_{3+1}

34. (a) Z-scheme involves two PS - I and PS - II. PS - I is associated in cyclic photophosphorylation. Cyclic photophosphorylation results in the synthesis of ATP only. It occurs in stroma lamellae.

35. (a) Creation of proton gradient in the intermembrane space. Breakdown of this gradient releases energy for ATP synthesis.

36. (a)



Reduced P_{700} passes its electrons to ferredoxin (Fd) present at outer surface of thylakoid membranes.

37. (d) Creation of proton gradient across thylakoid membrane is prerequisite. Breakdown of this proton gradient leads to release of energy. This energy activates ATP and catalyses that catalyses ATP formation.

38. (b) In the process of photosynthesis, the phosphorylation of ADP to form ATP using the energy of sunlight is called photophosphorylation.

39. (b) Process of photosynthesis takes place in two successive stages - light reaction and dark reaction. ATP & $NADPH_2$ are the products of light reaction which are used in dark reaction.

40. (a) Chlorophyll, found in endoplasm of plants, absorb light energy for the process of photosynthesis to take place.

41. (b) Cytochromes are iron containing heme proteins that are primarily responsible for the generation of ATP via electron transport.

42. (b) In first step of photosynthesis, chlorophyll is light - dependent reaction capture the light energy and then use it to make ATP and NADPH.

43. (a) Light reaction is the first stage of photosynthesis in which chlorophyll molecules absorb light energy which is then used to make up the ATP & $NADPH_2$.

44. (d) Cytochrome P_{450} are proteins of superfamily containing heme as a cofactor.

45. (d) Photosystem I is an integral membrane protein complex that uses light energy to produce high energy carriers ATP & $NADPH_2$.

46. (a) Chemiosmotic theory explains the functioning of electron transport chains in mitochondria & chloroplasts. According to this theory, the transfer of electrons down an electron transport system through a series of oxidation - reduction reactions release ATP.

47. (b) Cyclic photophosphorylation reaction produces ATP but it does not produce O_2 or $NADPH$. Non - cyclic photophosphorylation is carried out using P_{700} in photosystem I & P_{680} in photosystem II & it produces NADPH & ATP.

48. (c) Photosystems are located in thylakoid membrane of plants, algae & cyanobacteria. PS I is located at the outer surface of grana thylakoid membrane (stroma lamellae) and PS II is located at the inner surface of the grana thylakoid membrane.

49. (a) Ferredoxins are iron - sulfur proteins that mediate electron transfer in a range of metabolic reactions. It is the primary electron acceptor of photosystem I

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50. (c) Dark reactions occurs in the stroma of the chloroplast.

51. (d) H^+ ions produced by the splitting of water reduces the NADP to NADPH during non-cyclic photophosphorylation of photosynthesis.

52. (d) It is the dark reaction (or light independent reaction) that convert CO_2 & other compounds into glucose.

53. (c) In one Calvin cycle

In	Out
Six CO_2	One glucose
18 ATP	18 ADP
12 NADPH	12 NADP

54. (a) The fixation of one CO_2 molecule into one molecule of triose phosphate during the Calvin cycle requires 2 ATP and 2 NADPH molecules.

55. (b) Energy from sunlight is converted into a small amount of ATP and an energy carrier, NADPH during light reaction. Also, splitting of water takes place and oxygen is released.

56. (c) Melvin Calvin used radioactive ^{14}C in alga (*Chlorella*) that led to the discovery that the first product of CO_2 fixation is PGA.

57. (b) First step of Calvin cycle (dark reaction) is CO_2 fixation in which a CO_2 molecule combines with 5 - carbon RuBP to make a 6-carbon compounds that splits into two molecules of a 3-carbon compound, 3-phosphoglyceric acid (a stable product).

58. (b) Stomatal opening is induced by abiotic factors such as low carbon dioxide concentration, high atmospheric humidity and light.

59. (c) Reactions of the Calvin cycle add one carbon to a simple five-carbon molecule, RuBP. 6 cycles of Calvin cycle are required to produce one glucose molecule (C-6).

60. (c) Two $NADPH_2$ and three ATP are needed for the assimilation of one carbon dioxide molecule.

1. (d) 6 rounds of Calvin cycle are required to fix 6 CO_2 molecules & generate one glucose (a hexose).

2. (b) In C_3 plants, carbon fixation is done by RuBisCO enzyme that adds CO_2 to RuBP (Ribulose - 1,5 - bisphosphate).

3. (b) In C_3 cycle the primary acceptor of carbon dioxide is RuBP (Ribulose - 1,5 - bisphosphate). In C_4 plants, PEP accepts CO_2.

4. (c) Calvin cycle is named after American chemist Melvin Calvin. He mapped the complete conversion of carbon within a plant during the process of photosynthesis, for which he used radioactive isotope of ^{14}C.

5. (c) Both Statement I and Statement II are correct

RuBisCO is the most abundant enzyme in the world. Photorespiration does not occur in C_4 plants. C_4 plants have a special type of leaf anatomy called 'Kranz anatomy' and have evolved a mechanism that increases the concentration of CO_2 at the enzyme site, thus, photorespiration does not occur.

66. (c) The particularly large cells around the vascular bundles of the C_4 pathway plants are called bundle sheath cells. The bundle sheath cells may form several layers around the vascular bundles; they are characterised by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.

67. (b) Plants that are adapted to dry tropical region have C_4 pathway and called as C_4 plants e.g., grass, maize, sorghum, sugarcane etc. This pathway is also known as Hatch and Slack pathway. The primary CO_2 acceptor is a 3-carbon molecule phosphoenol pyruvate (PEP) and is present in the mesophyll cells. The enzyme responsible for this fixation is PEP carboxylase or PEPcase. Mesophyll cells lack RuBisCO enzyme.

68. (a) *Sorghum* is an example of C_4 plant. The first stable product formed is oxaloacetic acid or oxaloacetate.

Succinic acid is formed in Krebs cycle.

3-Phosphoglyceric acid is the first stable product of C_3 cycle.

Pyruvic acid is the final product of glycolysis.

69. (a) The oxygenation activity of RuBisCo enzyme in photorespiration leads to the formation of one molecule of 3-phosphoglycerate (PGA) and one molecule of 2-phosphoglycolate (2PG or PG). 3-phosphoglycerate is a 3C compound while 2-phosphoglycolate is a 2C compound.

70. (a) In C_4 plants, the mesophyll cells lack RuBisCO enzyme. The bundle sheath cells are rich in RUBisCO.

71. (b) PEP is 3C compound which serves as primary CO_2 acceptor in the mesophyll cell cytoplasm of C_4 plants like maize, sugarcane, *Sorghum*, etc.

72. (a) The process which makes a major difference between C_3 and C_4 plants is photorespiration.

C_4 plants have a special type of leaf anatomy, they tolerate higher temperatures, they show a response to high light intensities, and they lack a process called photorespiration and have greater productivity of biomass.

73. (b) C_4 plants are special: They have a special type of leaf anatomy, they tolerate higher temperatures, and they show a response to high light intensities, they lack a process called photorespiration.

74. (b) Pea - C_3 pathway, non-endospermic seed, vexillary aestivation.

Tomato - Twisted aestivation, axile placentation, berry fruit.

Maize - C_4 pathway, closed vascular bundle.

Onion - Bulb, axile placentation, perianth.

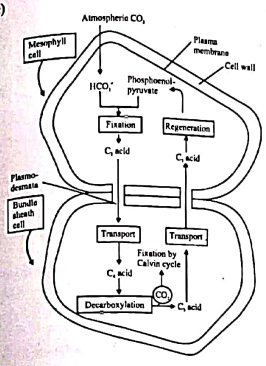
75. (a) A process that makes important difference between C_3 and C_4 plants is photorespiration.

76. (d) The correct sequence of cell organelles during photorespiration is chloroplast, mitochondria, peroxisome.

77. (d) In Kranz anatomy, seen in C_4 plants (maize and sugarcane), the bundle sheath cells have thick walls, no intercellular spaces and large number of chloroplasts. These modifications helps to tolerate plants in adverse conditions (high temperature/drought, etc).

78. (b) Crassulacean acid metabolism (CAM): This is a special type of mechanism to conserve water. CAM plants are succulents with water storing cells.

79. (c)



80. (b) C_4 plants have Kranz anatomy in which vascular bundles are surrounded by bundle sheath cells. Bundle sheath cells have a large number of chloroplast.

81. (d) The oxalic acid is reduced to malic acid in mesophyll cells. Malic acid from chloroplast of mesophyll cells goes into bundle sheath cells where it undergo decarboxylation to release CO_2 and pyruvate.

82. (c) First reaction of photorespiration occurs in stroma of chloroplast. In this reaction, the RuBP consume 1 molecule of O_2 in the presence of RuBisCO.

In peroxisomes, the glycolate transferred from chloroplast takes up O_2 and formed the glyoxylate whereas the H_2O_2 releases as byproduct.

83. (d) CO_2 fixation in C_4 plants takes place in two cells. First in mesophyll cell then in the bundle sheath cell. CO_2 is primarily fixed by PEPcase because this enzyme has greater affinity to CO_2 than RuBisCO.

84. (c) C_4 plants do not undergo photorespiration due to their special mechanism to increase the CO_2 level for enzyme binding. The presence of PEP carboxylase in C_4 and CAM plants reduces photorespiration.

85. (c) Crassulacean acid metabolism, also known as CAM photosynthesis, is a carbon fixation pathway that evolved in some plants as an adaptation to arid conditions. In CAM plants, the stomata in the leaves remain shut during the day to reduce evapotranspiration, but open at night to collect CO_2.

86. (b) Sugarcane is a C_4 plant in which CO_2 is fixed in malic acid by PEP carboxylase.

87. (a) Maize is a C_4 plant that forms C_4 acid via carbon fixation.

88. (d) PEP-carboxylase plays a key role in binding CO_2 in the form of bicarbonate with PEP to create oxaloacetate in mesophyll tissue.

89. (c) Photorespiration rates are increased by lowered CO_2 & increased O_2 concentration availability.

90. (a) PEP carboxylase binds CO_2 in the form of HCO_3^- with phosphoenol pyruvate (PEP) to form oxaloacetate.

91. (c) In C_4 plants, carbon-fixation pathway begins in the mesophyll cells where CO_2 is converted to HCO_3^- which is then added to PEP.

92. (c) In mesophyll cells of C_4 plants, CO_2 is fixed by PEP - carboxylase to form oxaloacetate from phosphoenol pyruvate.

93. (d) Maize is an example of C_4 plant as C_4 pathway takes place in it.

94. (b) PEP carboxylase catalyses the fixation of carbon dioxide by phosphoenol pyruvate (PEP) in mesophyll cells of C_4 plants.

95. (a) In C_4 plants, primary acceptor of carbon dioxide is three carbon phosphoenol pyruvate (PEP).

96. (a) Kranz anatomy is the special structure of leaves in C_4 plants where tissue equivalent to spongy mesophyll cell is clustered in a ring around the leaf - veins, outside the bundle sheath cells.

97. (b) Photorespiration is a type of respiration which occurs in green cells in presence of light. It involves three organelles - chloroplast, peroxisomes and mitochondria. Respiratory substrate in photorespiration is a 2-carbon compound glycolic acid (2C), hence called C_2 cycle.

98. (a) Calvin cycle is a series of biochemical redox reactions that takes place in the stroma of chloroplast in photosynthetic organisms. In the C_4 plants, initial carbon fixation takes place in mesophyll cells and the Calvin cycle takes place in bundle-sheath cells.

99. (c) C_4 plants tolerate wide range of temperature.

100. (d) The size of photosynthetic unit is defined as number of light - absorbing pigment molecules contributing excitation energy to a reaction center. All shade plants have larger photosynthetic unit size than sun plants.

101. (a) Rate of photosynthesis is maximum in red light & blue light. Phytoplanktons (algae or cyanobacteria) absorb red & blue light most efficiently.

102. (c) Blackman proposed the law of limiting factors in 1905. According to this law, when a process depends on a number of factors, its rate is limited by the pace of slowest factor.

103. (a) Light independent reactions of photosynthesis are dependent on temperature. These reaction are enzyme dependent, therefore, temperature above than 35°C, is out of range of optimal temperature for enzymes, decreases the functional activity of enzymes & decline the rate of photosynthesis.

104. (b) Rate of yield is dependent on light as photosynthesis is dependent on light. Maximum rate of photosynthesis occur when light is brightest. But during monsoon, the light is dim and so this reduces rate of photosynthesis and hence yield.

105. (b) Sugarcane is one of the most efficient photosynthesisers in plant kingdom. It is a C_4 plant, able to convert up to 1% of incident solar energy into biomass. As it grows, sugarcane converts sunlight into chemical energy which it stores inside the plant.

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CHAPTER 12

Respiration in Plants

Do Plants Breathe?

1. Life without air would be: *(1993)*
   a. Reductional
   b. Free from oxidative damage
   c. Impossible
   d. Anaerobic

Glycolysis & Fermentation

2. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R: **[MR*]** *(2023)*

   Assertion A: ATP is used at two steps in glycolysis.

   Reason R: First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6- phosphate into fructose-1-6-diphosphate.

   In the light of the above statements, choose the correct answer from the options given below is true,
   a. A is false but R is true.
   b. Both A and R are true and R is the correct explanation of A
   c. Both A and R are true but R is NOT the correct explanation of A.
   d. A is true but R is false.

3. What is the net gain of ATP when each molecule of glucose is converted to two molecules of pyruvic acid? *(2022)*
   a. Eight
   b. Four
   c. Six
   d. Two

4. What amount of energy is released from glucose during lactic acid fermentation? *(2022)*
   a. Less than 7%
   b. Approximately 15%
   c. More than 18%
   d. About 10%

5. Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalysed by *(2019)*
   a. Aldolase
   b. Hexokinase
   c. Enolase
   d. Phosphofructokinase

6. In which one of the following processes CO_2 is not released? *(2014)*
   a. Lactate fermentation
   b. Aerobic respiration in plants
   c. Aerobic respiration in animals
   d. Alcoholic fermentation

7. The energy releasing metabolic process in which substrate is oxidised without an external electron acceptor is: *(2010 Pre, 2008)*
   a. Fermentation
   b. Aerobic respiration
   c. Photorespiration
   d. Glycolysis

8. Energy releasing process in which substrate is oxidised without an external electron acceptor is: *(2008)*
   a. Aerobic respiration
   b. Fermentation
   c. Photorespiration
   d. Glycolysis

9. Overall goal of glycolysis, Krebs cycle and electron transport system is formation of: *(2007)*
   a. ATP in small stepwise units
   b. ATP in one large oxidation reaction
   c. Sugars
   d. Nucleic acid

10. In glycolysis, during oxidation electrons are removed by: *(2004)*
    a. Glyceraldehyde-3-phosphate
    b. NAD
    c. Molecular oxygen
    d. ATP

11. Dough kept overnight in warm weather becomes soft and spongy because of: *(2004)*
    a. Fermentation
    b. Cohesion
    c. Osmosis
    d. Absorption of carbon dioxide from atmosphere

12. In alcohol fermentation: *(2003)*
    a. Triose phosphate is the electron donor while acetaldehyde is the electron acceptor
    b. Triose phosphate is the electron donor while pyruvic acid is the electron acceptor
    c. There is no electron donor
    d. Oxygen is the electron acceptor

13. How many ATP molecules produced by aerobic oxidation of one molecule of glucose? *(2002)*
    a. 2
    b. 4
    c. 38
    d. 34

14. The end products of fermentation are: *(1997)*
    a. O_2 and C_2H_5OH
    b. CO_2 and acetaldehyde
    c. CO_2 and O_2
    d. CO_2 and C_2H_5OH

15. Which of the following products are obtained by anaerobic respiration from yeast? *(1996)*
    a. Beer and Wine
    b. Alcohols
    c. CO_2
    d. All of these

16. At the end of glycolysis, six carbon compound ultimately changes into: *(1996)*
    a. Ethyl alcohol
    b. Acetyl Co-A
    c. Pyruvic acid
    d. ATP

17. When yeast ferments glucose, the products obtained are: *(1994)*
    a. Ethanol and CO_2
    b. Methanol and CO_2
    c. Ethanol and water
    d. Water and CO_2

18. The first phase in the breakdown of glucose, in animal cell, is: *(1994)*
    a. Fermentation
    b. Krebs' cycle
    c. Glycolysis
    d. E.T.S.

19. Plants, but not animals, can convert fatty acids, to sugars by a series of reactions called: *(1994)*
    a. Photosynthesis
    b. Kreb's cycle
    c. Glycolysis
    d. Glyoxylate cycle

20. End product of glycolysis is: *(1990)*
    a. Acetyl CoA
    b. Pyruvic acid
    c. Glucose 1-phosphate
    d. Fructose 1-phosphate

Aerobic Respiration

21. Math List-I with List-II **[MR*]** *(2023)*

List-I		List-II	
(A)	Oxidative decarboxylation	(I)	Citrate synthase
(B)	Glycolysis	(II)	Pyruvate
(C)	Oxidative phosphorylation	(III)	Electron transport system
(D)	Tricarboxylic acid cycle	(IV)	EMP pathway

Choose the correct answer from the options given below:
a. A-II, B-IV, C-III,, D-I
b. A-III, B-IV, C-II,, D-I
c. A-II, B-IV, C-I,, D-III
d. A-III, B-I, C-II,, D-IV

22. How many times decarboxylation occurs during each TCA cycle? *(2023-Manipur)*
    a. Thrice
    b. Many
    c. Once
    d. Twice

23. The 5-C compound formed during TCA cycle is: *(2022 Re)*
    a. Fumaric acid
    b. α-ketoglutaric acid
    c. Oxalo succinic acid
    d. Succinic acid

24. The number of time(s) decarboxylation of isocitrate occurs during single TCA cycle is: *(2022 Re)*
    a. Four
    b. One
    c. Two
    d. Three

25. Which of the following statements is incorrect? **[MR*]** *(2021)*
    a. In ETC (Electron Transport Chain), one molecule of NADH + H^+ gives rise to 2 ATP molecules, and one $FADH_2$ gives rise to 3 ATP molecules.
    b. ATP is synthesized through complex V.
    c. Oxidation - reduction reactions produce proton gradient in respiration,
    d. During aerobic respiration, role of oxygen is limited to the terminal stage.

26. The number of substrate level phosphorylations in one turn of citric acid cycle is: *(2020)*
    a. One
    b. Two
    c. Three
    d. Zero

27. Pyruvate dehydrogenase activity during aerobic respiration requires: *(2020-Covid)*
    a. Iron
    b. Cobalt
    c. Magnesium
    d. Calcium

28. What is the role of NAD^+ in cellular respiration? *(2018)*
    a. It functions as an enzyme
    b. It functions as an electron carrier
    c. It is a nucleotide source for ATP synthesis
    d. It is the final electron acceptor for anaerobic respiration

29. Which of these statements is incorrect? *(2018)*
    a. Enzymes of TCA cycle are present in mitochondrial matrix.
    b. Glycolysis occurs in cytosol.
    c. Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms.
    d. Oxidative phosphorylation takes place in outer mitochondrial membrane.

30. Which statement is wrong for Krebs' cycle? **[MR*]** *(2017-Delhi)*
    a. There are three points in the cycle where NAD^+ is reduced to NADH + H^+
    b. There is one point in the cycle where FAD^+ is reduced to $FADH_2$
    c. During conversion of succinyl CoA to succinic acid, a molecule of GTP is synthesised
    d. The cycle starts with condensation of acetyl group (acetyl CoA) with pyruvic acid to yield citric acid

31. Oxidative phosphorylation is: *(2016 - II)*
    a. Addition of phosphate group to ATP.
    b. Formation of ATP by energy released from electrons removed during substrate oxidation.
    c. Formation of ATP by transfer of phosphate group from a substrate to ADP.
    d. Oxidation of phosphate group in ATP.

32. Cytochromes are found in: *(2015)*
    a. Cristae of mitochondria
    b. Lysosomes
    c. Matrix of mitochondria
    d. Outer wall of mitochondria

33. In mitochondria, protons accumulate in the: *(2011 Mains)*
    a. Inner membrane space
    b. Matrix
    c. Outer membrane
    d. Inner membrane

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34. Enzyme of TCA which is located in inner mitochondrial membrane in eukaryotes and cytosol in prokaryotes is: *(2007)*
a. Lactate dehydrogenase
b. Malate dehydrogenase
c. Isocitrate dehydrogenase
d. Succinate dehydrogenase

35. In which one of the following do the two names refer to one and the same thing? *(2003)*
a. Kreb's cycle and Calvin cycle
b. Tricarboxylic acid cycle and citric acid cycle
c. Citric acid cycle and Calvin cycle
d. Tricarboxylic acid cycle and urea cycle

36. Which of the following is the key intermediate compound linking glycolysis to the Krebs' cycle? *(1997)*
a. Malic acid b. Acetyl CoA
c. NADH d. ATP

37. In Krebs' cycle, the FAD precipitates as electron acceptor during the conversion of: *(1997)*
a. Fumaric acid to malic acid
b. Succinic acid to fumaric acid
c. Succinyl CoA to succinic acid
d. α-ketoglutarate to succinyl CoA

38. The correct sequence of electron acceptor in ATP synthesis is: *(1997)*
a. Cyt. *b, c, a_1, a* b. Cyt. *c, b, a, a_3*
c. Cyt. *a, a_3, b, c* d. Cyt. *b, c, a, a_3*

39. The 1992 Nobel Prize for medicine was awarded to Edmond H. Fischer and Edwin J. Krebs for their work concerning: **[OS]** *(1994)*
a. Reversible protein phosphorylation as a biological regulation mechanism
b. Isolation of the gene for a human disease
c. Human genome project
d. Drug designing involving inhibition of DNA synthesis of the pathogen

40. Poisons like cyanide inhibit Na^+ efflux and K^+ influx during cellular transport. This inhibitory effect is reversed by an injection of ATP. This demonstrates that: **[OS]** *(1994)*
a. ATP is the carrier protein in the transport system
b. Energy for Na^+-K^+ exchange pump comes from ATP
c. ATP is hydrolysed by ATPase to release energy
d. Na^+ - K^+ exchange pump operates in the cell

41. End product of citric acid cycle/Krebs' cycle is: *(1993)*
a. Citric acid b. Lactic acid
c. Pyruvic acid d. $CO_2 + H_2O$

42. When one glucose molecule is completely oxidised, it changes: *(1992)*
a. 36 ADP molecules into 36 ATP molecules
b. 38 ADP molecules into 38 ATP molecules
c. 30 ADP molecules into 30 ATP molecules
d. 32 ADP molecules into 32 ATP molecules

43. Oxidative phosphorylation is production of: *(1992)*
a. ATP in photosynthesis b. NADPH in photosynthesis
c. ATP in respiration d. NADH in respiration

44. End products of aerobic respiration are: *(1992)*
a. Sugar and oxygen
b. Water and energy
c. Carbon dioxide, water and energy
d. Carbon dioxide and energy

45. Link between glycolysis, Krebs' cycle and β-oxidation of fatty acid or carbohydrate and fat metabolism is: **[MR*]** *(1992)*
a. Oxaloacetic acid b. Succinic acid
c. Citric acid d. Acetyl CoA

46. Terminal cytochrome of respiratory chain which donates electrons to oxygen is *(1992)*
a. Cyt. b b. Cyt. c
c. Cyt. a_1 d. Cyt. a_3

47. Connecting link between glycolysis and Krebs' cycle before pyruvate entering Krebs' cycle is changed to: *(1990)*
a. Oxaloacetate b. PEP
c. Pyruvate d. Acetyl CoA

48. EMP can produce a total of: *(1990)*
a. 6 ATP b. 8 ATP
c. 24 ATP d. 38 ATP

49. $NADP^+$ is reduced to NADPH in: *(1988)*
a. HMP b. Calvin Cycle
c. Glycolysis d. EMP

Respiratory Balance Sheet & Amphibolic Pathway

50. Fatty acids are connected with the respiratory pathway through: *(2023-Manipur)*
a. Acetyl CoA
b. α–Ketoglutaric acid
c. Dihydroxy acetone phosphate
d. Pyruvic acid

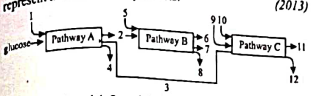
51. Match List-I with List-II: **[MR*]** *(2022 Re)*

List-I		List-II	
(A)	Porins	(I)	Pink coloured nodules
(B)	leg haemoglobin	(II)	Lumen of thylakoid
(C)	H^+ accumulation	(III)	Amphibolic pathway
(D)	Respiration	(IV)	Huge pores in outer membrane of mitochondria

Choose the correct answer from the options given below:
a. A-II, B-IV, C-I, D-III b. A-II, B-I, C-IV, D-III
c. A-IV, B-I, C-II, D-III d. A-III, B-IV, C-II, D-I

52. Which of the following biomolecules is common to respiration-mediated breakdown of fats, carbohydrates and proteins? *(2016 - II, 2003)*
a. Pyruvic acid b. Acetyl CoA
c. Glucose-6-phosphate d. Fructose 1,6-bisphosphate

53. The three boxes in this diagram represent the three major biosynthetic pathways in aerobic respiration. Arrows represent net reactants or products: *(2013)*



Arrows numbered 4, 8, and 12 can all be
a. FAD* or $FADH_2$ b. NADH
c. ATP d. H_2O

54. Aerobic respiratory pathway is appropriately termed: *(2009)*
a. Anabolic b. Catabolic
c. Amphibolic d. Parabolic

55. How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and useful chemical energy available in high energy phosphate bond of one mole of ATP is 12 kcal? **[OS]** *(2006)*
a. 1 b. 2
c. 30 d. 57

56. During which stage in the complete oxidation of glucose are the greatest number of ATP molecules formed from ADP? *(2005)*
a. Glycolysis
b. Krebs cycle
c. Conversion of Pyruvic acid to Acetyl CoA
d. Electron transport chain

57. Which of the following yield maximum energy? *(1999)*
a. By glycolysis in a sprinter
b. Aerobic respiration in germinating seeds
c. Fermentation by yeast
d. Anaerobic respiration

58. When one molecule of ATP is disintegrated, what amount of energy is liberated? *(1996)*
a. 8 kcal b. 38 kcal
c. 7 kcal d. 4.5 kcal

59. Out of 38 ATP molecules produced per glucose, 32 ATP molecules formed from NADH/$FADH_2$ in: **[MR*]** *(1993)*
a. Respiratory chain
b. Krebs' cycle
c. Oxidative decarboxylation
d. EMP

60. Out of 36 ATP molecules produced per glucose molecule during respiration: *(1992)*
a. 2 are produced outside glycolysis and 34 during respiratory chain
b. 2 are produced outside mitochondria and 34 inside mitochondria
c. 2 during glycolysis and 34 during Krebs cycle
d. All are formed inside mitochondria

Respiratory Quotient

61. Respiratory Quotient (RQ) value of tripalmitin is *(2019)*
a. 0.9 b. 0.7
c. 0.07 d. 0.09

62. Oxidation of palmitic acid yield: *(1998)*
a. 129 ATP b. 132 ATP
c. 38 ATP d. 76 ATP

63. The ultimate respiratory substrate, yielding maximum number of ATP molecules, is: *(1994)*
a. Glycogen b. Ketogenic amino acid
c. Glucose d. Amylose

64. Apparatus to measure rate of respiration and R.Q. is: **[OS]** *(1992)*
a. Auxanometer b. Potometer
c. Respirometer d. Manometer

65. R.Q. is ratio of: *(1990)*
a. CO_2 produced to substrate consumed
b. CO_2 produced to O_2 consumed
c. Oxygen consumed to water produced
d. Oxygen consumed to CO_2 produced

66. R.Q. is: *(1988)*
a. C/N b. N/C
c. CO_2/O_2 d. O_2/CO_2

Answer Key

1. (d)	2. (b)	3. (d)	4. (a)	5. (b)	6. (a)	7. (a)	8. (b)	9. (a)	10. (b)
11. (a)	12. (a)	13. (c)	14. (d)	15. (d)	16. (c)	17. (a)	18. (c)	19. (d)	20. (b)
21. (a)	22. (d)	23. (b)	24. (b)	25. (a)	26. (a)	27. (c)	28. (b)	29. (d)	30. (d)
31. (b)	32. (a)	33. (a)	34. (d)	35. (b)	36. (b)	37. (b)	38. (d)	39. (a)	40. (b)
41. (d)	42. (b)	43. (c)	44. (c)	45. (d)	46. (d)	47. (d)	48. (b)	49. (a)	50. (a)
51. (c)	52. (b)	53. (c)	54. (c)	55. (d)	56. (d)	57. (b)	58. (c)	59. (a)	60. (b)
61. (b)	62. (a)	63. (c)	64. (c)	65. (b)	66. (c)				

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Explanations

1. **(d)** Anaerobic respiration (absence of oxygen) takes place in anaerobic bacteria and in plant seeds. Anaerobic respiration occurs in the organism which can live without oxygen. In this respiration, only glycolysis takes place due to the absence of oxygen.

2. **(b)** ATP is utilised at two steps: first in the conversion of glucose into glucose 6-phosphate and second in the conversion of fructose 6-phosphate to fructose 1, 6-bisphosphate.

3. **(d)** Glycolysis occurs in the cytoplasm of the cell and is present in all living organisms. In this process, glucose undergoes partial oxidation to form two molecules of pyruvic acid.

   During this process, total 4 ATPs are formed, out of which 2 ATPs are consumed. 2 ATPs are formed during the conversion of 1,3 bisphosphoglyceric acid to 3 phosphoglyceric acid catalyzed by the enzyme phosphoglycerate kinase and the other 2 ATPs are formed by the conversion of phosphoenol pyruvic acid to pyruvic acid by the enzyme pyruvate kinase. Therefore, there will be a net gain of 2 ATPs.

4. **(a)** Fermentation refers to the incomplete oxidation of glucose is achieved under anaerobic conditions by sets of reactions where pyruvic acid is converted to CO_2 and ethanol. In lactic acid fermentation, less than seven per cent of the energy in glucose is released and not all of it is trapped as high energy bonds of ATP.

5. **(b)** Hexokinase catalyse the conversion of glucose to glucose-6 phosphate. It is the first step of activation phase of glycolysis.

6. **(a)** The end product of lactate fermentation is lactic acid only.

7. **(a)** Fermentation involves incomplete breakdown of glucose (oxidation) under anaerobic conditions by sets of reactions.

8. **(b)** Fermentation involves incomplete breakdown of glucose (oxidation) under anaerobic conditions by sets of reactions.

9. **(a)** Glycolysis, Kreb's cycle and ETC are meant for ATP synthesis in different steps.

10. **(b)** NAD (Nicotinamide adenine dinucleotide) serves as an electron acceptor in glycolysis. It accepts its electrons with a proton to convert into NADH.

11. **(a)** During fermentation, the yeast is allowed to leaven the dough and make it soft & spongy. In a hot atmosphere (30-40°C), alcoholic fermentation by yeast convert carbohydrates to CO_2 causing gas bubbles to form & has a leaving effect on dough.

12. **(a)** In alcohol fermentation, acetaldehyde, an electron acceptor, reacts with NADH to form ethanol.

13. **(c)** Anaerobic respiration makes a total of 2 ATP by glycolysis only. Whereas, aerobic respiration is much more efficient & can produce up to 38 ATP with a single molecule of glucose.

14. **(d)** At the end of fermentation reaction, carbon dioxide and ethanol are produced. Yeast is used to ferment sugar carbohydrates such as starch in beverage industries to produce alcohol.

15. **(d)** Anaerobic respiration is the breakdown of glucose in the absence of oxygen. It this, carbohydrates are broken down into alcohols & carbon dioxide by the yeast.

16. **(c)** Glycolysis or EMP pathway is the breakdown of glucose into two molecules of pyruvic acid through a series of enzyme mediated reaction releasing energy. Pyruvic acid is a 3-carbon compound.

17. **(a)** Ethanol and carbon dioxide are produced by the fermentation of one molecule of glucose under anaerobic conditions.

18. **(c)** Glycolysis is the metabolic pathway that converts glucose into pyruvate under anaerobic conditions. It is the first step in cellular respiration and occurs with variations in almost all organisms, both aerobic & anaerobic.

19. **(d)** Glyoxylate cycle is a variation of tricarboxylic acid cycle occuring in plants, bacteria, protists and fungi. It converts fat acetyl - CoA to succinate for the synthesis of carbohydrates.

20. **(b)** 2 molecules of pyruvic acid are formed from one molecule of glucose at the end of glycolysis.

21. **(a)** Pyruvate when enters into mitochondrial matrix, it undergoes oxidative decarboxylation by a complex set of reactions catalysed by pyruvic dehydrogenase.

    Glycolysis often referred to as the EMP pathway.

    Oxidative phosphorylation is a process embedded in the inner membrane of mitochondria (called electron transport chain and ATP synthase). The reaction in TCA cycle catalysed by the enzyme citrate synthase.

22. **(d)** During the Tricarboxylic Acid (TCA) cycle decarboxylation occurs twice, removing two CO_2 molecules. The first decarboxylation happens in the conversion of isocitrate to α-ketoglutarate, and the second in the transformation of α-ketoglutarate to succinyl-CoA.

23. **(b)** α-Ketoglutaric acid is the 5-carbon compound formed during the TCA (tricarboxylic acid) cycle. Fumaric acid and Succinic acid are 4 carbon, Oxalosuccinic acid is 6 carbon.

24. **(b)** During a single TCA cycle, isocitrate undergoes decarboxylation one time, leading to the production of alpha-ketoglutarate and the release of one molecule of carbon dioxide.

25. **(a)** One molecule of $NADH + H^+$ give rise to 3 ATP while one molecule of $FADH_2$ forms 2 ATP molecules. Rest three statements are correct.

26. **(a)** The number of substrate level phosphorylations in one turn of citric acid cycle is 1.

27. **(c)** Pyruvate, which is formed by the glycolytic catabolism of carbohydrates in the cytosol, after it enters mitochondrial matrix undergoes oxidative decarboxylation by a complex set of reactions catalysed by pyruvic dehydrogenase. The reactions catalysed by pyruvic dehydrogenase require the participation of magnesium ions.

28. **(b)** NAD^+ is an oxidising agent that accepts the electrons from other molecules and becomes reduced to form NADH. NADH, then can be used to donate electrons. In this way NAD^+ acts as an electron carrier.

29. **(d)** Oxidative phosphorylation takes place in inner mitochondrial membrane.

30. **(d)** Krebs cycle starts with condensation of acetyl CoA (2C) with oxaloacetic acid (4C) to form citric acid (6C).

31. **(b)** Unlike photophosphorylation where it is the light energy that is utilized for the production of proton gradient required for phosphorylation, in respiration it is the energy of oxidation-reduction utilized for the same process. It is for this reason that the process is called oxidative phosphorylation.

32. **(a)** The inner mitochondrial membrane forms a number of infoldings called the cristae towards the matrix. Inner mitochondrial membrane is the site of electron transport chain in which cytochrome are arranged.

33. **(e)** In mitochondria, protons accumulate in the inner membrane space.

34. **(d)** Succinate dehydrogenase enzyme is present on inner mitochondrial membrane and catalysed the oxidation of succinate to fumarate.

35. **(b)** Tricarboxylic acid cycle or citric acid cycle are another names used for Kreb's cycle by which living cells breaks down organic fuel molecules in presence of oxygen to harvest the energy they need to grow & divide.

36. **(b)** Main function of Acetyl-CoA is to deliver the acetyl group to the Kreb cycle to be oxidised for energy production. Pyruvate, the product of glycolysis, is thus converted to acetyl - CoA in order to enter Kreb's cycle.

37. **(b)** Succinic acid is oxidised to fumaric acid via the enzyme succinate dehydrogenase. Protons & electrons released are accepted by FAD to become $FADH_2$.

38. **(d)** FAD, CoQ (ubiquinone), Cyt. b, Cyt. c_1, Cyt. c, Cyt. a and Cyt a_3.

39. **(a)** Fisher and Krebs were awarded the Nobel Prize to show the importance of reversible protein phosphorylation as a biological regulatory mechanism.

40. **(b)** It shows that inhibited Na^+ efflux & K^+ influx is regained by ATP action, i.e., ATP provides the energy for functioning of Na^+/K^+ pump

41. **(d)** In a single turn of citric acid cycle, two molecules of carbon dioxide are released, each during third & fourth steps of cycle respectively, which are conversion of isocitrate to α- ketoglutarate and formation of succinyl CoA from α- ketoglutarate.

42. **(b)** At the end of complete oxidation of one glucose molecule, 38 ATP molecules are formed.

43. **(c)** Oxidative phosphorylation is the process in which ATP is formed as a result of the transfer of electrons from NADH or $FADH_2$ to O_2 by a series of electron carriers.

44. **(c)** At the end of aerobic respiration (i.e., Kreb cycle), carbon dioxide, water & loss of energy is released in the cell. Released energy is the main required product of cellular respiration. CO_2 & H_2O are byproducts.

45. **(d)** Acetyl - CoA is a molecule that participates in many biochemical reactions in protein, carbohydrate and lipid metabolism, therefore, it acts as a connecting link between all such metabolic pathways. Its main function is to deliver the acetyl group to Kreb cycle to be oxidised for energy production.

46. **(d)** Cytochrome a_3 helps in transfer of electron to oxygen.

47. **(d)** Pyruvate (the product of glycolysis) is changed into acetyl CoA before entering into the Kreb's cycle. Acetyl-CoA provides acetyl group to kreb's cycle to be oxidized for energy production.

48. **(b)** EMP pathway is the most common type of glycolysis and final product of glycolysis is pyruvate with eight ATPs.

49. **(a)** HMP pathway generates NADPH molecules which are used as reductants in biosynthetic process under conditions when NADPH molecules are not generated by photosynthesis. Production of NADPH is not linked to ATP generation in pentose phosphate pathway.

50. **(a)** Acetyl CoA.

    Fatty acids are broken down into acetyl CoA molecules, which can then enter the citric acid cycle (also known as the tricarboxylic acid cycle or Krebs cycle). Acetyl CoA is a central molecule that connects various metabolic pathways.

51. **(c)**

    A. Porins- A protein which forms large pores in the outer membrane of chloroplasts, mitochondria and bacteria.

    B. Leg Haemoglobin- A pink pigment in leguminous plants, aids N_2 fixation by scavenging O_2.

    C. H^+-accumulation - Lumen of thylakoid

    D. Respiration–Amphibolic pathway a biochemical (includes both anabolic and catabolic processes)

52. **(b)** Acetyl CoA is common to respiration-mediated breakdown of fats, carbohydrates and proteins

53. **(c)** Pathway A is glycolysis and pathway B is kreb's cycle.

    ATP is generated at substrate level in glycolysis and in Kreb's cycle.

54. **(c)** The respiratory path involves both anabolism and catabolism so it is amphibolic pathway.

55. **(d)** 57 ATP molecules could be generated by 686 kcal energy.

    12 kcal energy produce → 1 ATP

    $686 \text{ kcal} \rightarrow \frac{686}{12} = 57 \text{ ATP}$

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56. (d) In electron transport chain, all $NADH_2$ and $FADH_2$ pass to electron carriers and yield 3 ATP for 1 $NADH_2$ and 2 ATP per $FADH_2$

Glycolysis - 4 ATP
Kreb's cycle - 2 ATP
ETS - 34 ATP

57. (b) Aerobic respiration is the most efficient form of respiration as it can produce the most ATP molecules from breaking down of one glucose molecule, i.e., 38 ATP per glucose.

58. (c) The last phosphate bond yields an energy equivalent of 7 kcal.

59. (a) During respiratory chain, complete degradation of one glucose molecule produces 38 ATP molecules. NAD and FAD is reduced to $NADH/FADH_2$.

60. (b) 2 molecules of ATP are produced outside mitochondria, i.e., during glycolysis and other 34 molecules of ATP are produced inside mitochondria from Kreb's cycle.

61. (b) Respiratory quotient (RQ) $= \frac{\text{Amount of } CO_2 \text{ evolved}}{\text{Amount of } O_2 \text{ consumed}}$

$2(C_{51}H_{98}O_6) + 145O_2 \rightarrow 102CO_2 + 98H_2O + \text{Energy}$

Tripalmitin

$RQ = \frac{102\ CO_2}{145\ O_2} = 0.7$

62. (a) Oxidation of palmitic acid results in the formation of 8 Acetyl - CoA, 7 $FADH_2$ and 7 NADH which in total produces 131 ATP. Since two ATPs are used during the oxidation, net yield of ATP becomes 129.

63. (c) Glucose is oxidised to produce maximum yield of ATP, i.e., 38 molecules of ATP from one molecule of 6-carbon glucose.

64. (c) Respirometer is a device by which the rate of consumption of oxygen in a living organism is measured.

65. (b) Respiratory quotient is the ratio of the volume of carbon dioxide evolved to that of oxygen consumed by an organism.

66. (c) Respiratory quotient measures the ratio of CO_2 produced to the oxygen consumed.

TEGM Kohinoor

CHAPTER 13

Plant Growth and Development

Growth

1. Which of the following statements is **not correct**? [MR*] *(2023-Manipur)*
   a. Phase of cell elongation of plant cells is characterized by increased vacuolation.
   b. Cells in the meristematic phase of growth exhibit abundant plasmodesmatal connections.
   c. Plant growth is generally determinate.
   d. Plant growth is measurable.

2. The process of growth is maximum during: *(2020)*
   a. Lag phase b. Senescence
   c. Dormancy d. Log phase

3. Typical growth curve in plants is: *(2015)*
   a. Stair-steps shaped b. Parabolic
   c. Sigmoid d. Linear

4. Opening of floral buds is: [OS] *(2007)*
   a. Autonomic movement of variation
   b. Paratonic movement of growth
   c. Autonomic movement of growth
   d. Autonomic movement of locomotion

5. Exponential growth is shown by: *(1999)*
   a. Unicellular forms
   b. A cell in tissue culture
   c. Embryo
   d. Multicellular plants

6. What is phytotron? [OS] *(1999)*
   a. A device to grow the plants in controlled environment
   b. Growing plants in green house.
   c. Radiation chamber to induce the mutations
   d. Apparatus to study the effect of light on plants.

7. Klinostat is employed in the study of: [OS] *(1993)*
   a. Osmosis b. Growth movements
   c. Photosynthesis d. Respiration

Differentiation, Dedifferentiation, Redifferentiation and Development

8. In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as: *(2023)*
   a. Senescence b. Differentiation
   c. Dedifferentiation d. Development

9. The ability of plants to follow different pathways in response to environment leading to formation of different kinds of structures is called: *(2022 Re)*
   a. Differentiation b. Redifferentiation
   c. Development d. Plasticity

10. The phenomenon by which the undividing parenchyma cells start to divide mitotically during plant tissue culture is called as: [MR*] *(2022 Re)*
    a. Secondary growth
    b. Differentiation
    c. Dedifferentiation
    d. Redifferentiation

11. Which one of the following plants does not show plasticity? *(2022)*
    a. Maize b. Cotton
    c. Coriander d. Buttercup

12. Plants follow different pathways in response to environment or phase of life to form different kinds of structures. This ability is called: *(2021)*
    a. Flexibility b. Plasticity
    c. Maturity d. Elasticity

13. If the growing plant is decapitated, then: *(1994)*
    a. Its growth stops
    b. Leaves become yellow and fall down
    c. Axillary buds are inactivated
    d. Axillary buds are activated

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Plant Growth Regulators

14. Spraying of which of the following phytohormone on juvenile conifers helps in hastening the maturity period, that leads to early seed production? *(2023)*

a. Abscisic Acid b. Indole-3-butyric Acid
c. Gibberellic Acid d. Zeatin

15. Which hormone promotes internode/petiole elongation in deep water rice? *(2023)*

a. 2, 4-D b. GA_3
c. Kinetin d. Ethylene

16. The phenomenon which is influenced by auxin and also played a major role in its discovery: *(2023-Manipur)*

a. Phototropism b. Root initiation
c. Gravitropism d. Apical Dominance

17. Match **List-I** with **List-II**. **[MR*]** *(2023-Manipur)*

List-I		List-II	
(A)	Auxin	(I)	Promotes female flower formation in cucumber
(B)	Gibberellin	(II)	Overcoming apical dominance
(C)	Cytokinin	(III)	Increase in the length of grape stalks
(D)	Ethylene	(IV)	Promotes flowering in pineapple

Choose the **correct** answer from the options given below:

a. A-II, B-I, C-IV, D-III b. A-IV, B-III, C-II, D-I
c. A-I, B-III, C-IV, D-II d. A-III, B-II, C-I, D-IV

18. Which of the following growth regulators is an adenine derivative? *(2022 Re)*

a. Abscisic acid b. Auxin
c. Cytokinin d. Ethylene

19. Production of Cucumber has increased manifold in recent years. Application of which of the following phytohormones has resulted in this increased yield as the hormone is known to produce female flowers in the plants: *(2022)*

a. Cytokinin b. ABA
c. Gibberellin d. Ethylene

The gaseous plant growth regulator is used in plants to: **[MR*]** *(2022)*

a. Kill dicotyledonous weeds in the fields
b. Speed up the malting process
c. Promote root growth and root hair formation to increase the absorption surface
d. Help overcome apical dominance

The plant hormone used to destroy weeds in a field is: *(2021)*

a. NAA b. 2, 4-D
c. IBA d. IAA

22. Name the plant growth regulator which upon spraying on sugarcane crop, increases the length of stem, thus increasing the yield of sugarcane crop. *(2020)*

a. Gibberellin b. Ethylene
c. Abscisic acid d. Cytokinin

23. Match the following concerning the activity/function and the phytohormone involved. **[MR*]** *(2020-Covid)*

1.	Fruit ripener	(i)	Abscisic acid
2.	Herbicide	(ii)	GA_3
3.	Bolting agent	(iii)	2, 4-D
4.	Stress hormone	(iv)	Ethephon

Select the correct option from following:

	(1)	(2)	(3)	(4)
a.	(iii)	(iv)	(ii)	(i)
b.	(iv)	(iii)	(ii)	(i)
c.	(iv)	(ii)	(i)	(iii)
d.	(ii)	(iii)	(iv)	(i)

24. Who coined the term 'Kinetin'? *(2020-Covid)*

a. Darwin b. Went
c. Kurosawa d. Skoog and Miller

25. It takes very long time for pineapple plants to produce flowers. Which combination of hormones can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield? **[MR*]** *(2019)*

a. Auxin and Ethylene
b. Gibberellin and Cytokinin
c. Gibberellin and Abscisic acid
d. Cytokinin and Abscisic acid

26. Fruit and leaf drop at early stages can be **prevented** by the application of: *(2017-Delhi)*

a. Cytokinins b. Ethylene
c. Auxins d. Gibberellic acid

27. You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots? *(2016 - II)*

a. Auxin and Abscisic acid
b. Gibberellin and Abscisic acid
c. IAA and Gibberellin
d. Auxin and Cytokinin

28. The Avena curvature is used for bioassay of: *(2016 -I)*

a. ABA b. GA
c. IAA d. Ethylene

29. What causes a green plant exposed to the light on only one side, to bend toward the source of light as it grows? *(2015)*

a. Light stimulates plant cells on the lighted side to grow faster.
b. Auxin accumulates on the shaded side, stimulating greater cell elongation there.
c. Green plants need light to perform photosynthesis.
d. Green plants seek light because they are phototropic.

30. Auxin can be bioassay by: **[OS]** *(2015 Re)*

a. Hydroponics
b. Potometer
c. Lettuce hypocotyl elongation
d. Avena coleoptile curvature

31. Dr. F. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly cut coleoptile stumps. Of what significance is this experiment? **[OS]** *(2014)*

a. It demonstrated polar movement of auxins
b. It made possible the isolation and exact identification of auxin
c. It is the basis for quantitative determination of small amounts of growth-promoting substances
d. It supports the hypothesis that IAA is auxin

32. Which one of the following growth regulators is known as 'stress hormone'? *(2014)*

a. Indole acetic acid b. Abscisic acid
c. Ethylene d. GA_3

33. During seed germination its stored food is mobilised by: *(2013)*

a. Gibberellin b. Ethylene
c. Cytokinin d. ABA

34. Which one of the following generally acts as an antagonist to gibberellins? *(2012 Mains)*

a. Zeatin b. Ethylene
c. ABA d. IAA

35. One of the commonly used plant growth hormone in tea plantation is: *(2010 Mains)*

a. Zeatin b. ABA
c. IAA d. Ethylene

36. Senescence is an active developmental cellular processes in the growth and functioning of a flowering plant, is indicated in: *(2008)*

a. Annual plants b. Floral parts
c. Leaf abscission d. Vessels and tracheids

37. Which one is not correctly matched? **[MR*]** *(2007)*

a. Cytokinin - Cell division
b. IAA - Cell wall elongation
c. Abscisic acid - Stomatal closure
d. Gibberellic acid - Leaf fall

38. How does pruning help in making hedge dense? *(2006)*

a. It releases wound hormones
b. Apical shoot grows faster after pruning
c. It frees axillary buds from apical dominance
d. It induces differentiation of new shoots from rootstock

39. Parthenocarpic fruits are produced by: *(2006)*

a. Treating plants with phenyl mercuric acetate
b. Treating plants with low concentrations of gibberellic acid and auxin
c. Removing androecium of flowers before release of pollen grains
d. Raising plants from vernalised seeds.

40. In callus culture, root can be induced by supply of: *(2005)*

a. Ethylene b. Gibberellin
c. Cytokinin d. Auxin

41. Cell elongation in internodal regions of the green plants takes place due to: *(2004)*

a. Cytokinins b. Gibberellins
c. Ethylene d. Indole acetic acid

42. Differentiation of shoot is controlled by: **[OS]** *(2003)*

a. High auxin : cytokinin ratio
b. High cytokinin : auxin ratio
c. High gibberellin : auxin ratio
d. High gibberellin : cytokinin ratio

43. Coconut milk factor is: *(2003)*

a. An auxin b. A gibberellin
c. Abscisic acid d. Cytokinin

44. Which breaks dormancy of potato tuber? *(2001)*

a. Gibberellin b. IAA
c. ABA d. Zeatin

45. Hormone responsible for senescence: *(2001)*

a. ABA b. Auxin
c. GA d. Cytokinin

46. Which of the following prevents the fall of fruits? *(2001)*

a. GA_3 b. NAA
c. Ethylene d. Zeatin

47. Which hormone is responsible for fruit ripening? *(2000)*

a. Ethylene b. Auxin
c. Ethyl chloride d. Cytokinin

48. If the apical bud has been removed then we observe: *(2000)*

a. More lateral branches b. More axillary buds
c. Plant growth stops d. Flowering stops

49. What is necessary for ripening for fruits? **[OS]** *(1998)*

a. 80% of ethylene b. Abscisic acid
c. 2,4 D d. A.M.O.-16

50. Which of the following induces morphogenesis in tissue culture? **[OS]** *(1998)*

a. Gibberellin b. Cytokinin
c. IAA d. Ethylene

51. Which weedicide can defoliate the complete forest? **[OS]** *(1998)*

a. 2,4-D b. AMO-1618
c. MH d. ABA

52. Gibberellic acid induces flowering: *(1997)*

a. In short day plants under long day conditions
b. In day-neutral plant under dark conditions
c. In some gymnospermic plants only
d. In long day plants under short day conditions

53. The movement of auxin is largely: **[OS]** *(1994)*

a. Centripetal b. Basipetal
c. Acropetal d. Both (a) and (c)

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54. Removal of apical bud results in: *(1993)*
a. Formation of new apical bud
b. Elongation of main stem
c. Death of plant
d. Formation of lateral branching

55. The regulator which retards ageing/senescence of plant parts is: *(1993)*
a. Cytokinin b. Auxin
c. Gibberellin d. Abscisic acid

56. The hormone produced during adverse environmental conditions is: *(1993)*
a. Benzyl aminopurine
b. Bichlorophenoxy acetic acid
c. Ethylene
d. Abscisic acid

57. Which is produced during water stress that brings stomatal closure? *(1993)*
a. Ethylene b. Abscisic acid
c. Ferulic acid d. Coumarin

58. Bananas can be prevented from over-ripening by: *(1992)*
a. Maintaining them at room temperature
b. Refrigeration
c. Dipping in ascorbic acid solution
d. Storing in a freezer

59. Apical dominance is caused by: *(1992)*
a. Abscisic acid in lateral bud
b. Cytokinin in leaf tip
c. Gibberellin in lateral buds
d. Auxin in shoot tip

60. Cytokinins: *(1992)*
a. Promote abscission
b. Influence water movement
c. Help retain chlorophyll
d. Inhibit protoplasmic streaming

61. Which is employed for artificial ripening of banana fruits? *(1992)*
a. Auxin b. Coumarin
c. Ethylene d. Cytokinin

62. Abscisic acid causes: *(1991)*
a. Stomatal closure b. Stem elongation
c. Leaf expansion d. Root elongation

63. The hormone responsible for apical dominance is: *(1991)*
a. IAA b. GA
c. ABA d. Florigen

64. A chemical believed to be involved in flowering is: *(1991)*
a. Gibberellin b. Kinetin
c. Florigen d. IBA

65. Hormone primarily connected with cell division is: *(1991, 1992)*
a. IAA b. NAA
c. Cytokinin/zeatin d. Gibberellic acid

66. Highest auxin concentration occurs: *(1990)*
a. In growing tips b. In leaves
c. At base of plant organs d. In xylem and phloem

67. Phytohormones are: *(1990)*
a. Chemical regulation flowering
b. Chemical regulation secondary growth
c. Hormones regulating growth from seed to adulthood
d. Regulators synthesised by plants and influencing physiological processes

68. Abscisic acid controls: *(1990)*
a. Cell division
b. Leaf fall and dormancy
c. Shoot elongation
d. Cell elongation and wall formation

69. Which of the following movement is not related to auxin level? *(1990)*
a. Bending of shoot towards light
b. Movement of root towards soil
c. Nyctinastic leaf movements
d. Movement of sunflower head tracking the sun

70. Leaf fall can be prevented with the help of: *(1989)*
a. Abscisic acid b. Auxins
c. Florigen d. Cytokinins

71. Mowing grass lawn facilities better maintenance because: *(1989)*
a. Wounding stimulates regeneration
b. Removal of apical dominance and stimulation of intercalary meristem
c. Removal of apical dominance
d. Removal of apical dominance and promotion of lateral meristem

72. Cut or excised leaves remain green for long if induced to root or dipped in: *(1988)*
a. Gibberellins b. Cytokinins
c. Auxins d. Ethylene

73. Gibberellins promote: *(1988)*
a. Seed germination b. Seed dormancy
c. Leaf fall d. Root elongation

Answer Key

1. (c)	2. (d)	3. (c)	4. (c)	5. (b)	6. (a)	7. (b)	8. (c)	9. (d)	10. (c)
11. (a)	12. (b)	13. (d)	14. (c)	15. (d)	16. (a)	17. (b)	18. (c)	19. (d)	20. (c)
21. (b)	22. (a)	23. (b)	24. (d)	25. (a)	26. (c)	27. (d)	28. (c)	29. (b)	30. (d)
31. (b)	32. (b)	33. (a)	34. (c)	35. (c)	36. (c)	37. (d)	38. (c)	39. (b)	40. (d)
41. (b)	42. (b)	43. (d)	44. (a)	45. (a)	46. (b)	47. (a)	48. (a)	49. (a)	50. (b)
51. (b)	52. (d)	53. (b)	54. (d)	55. (a)	56. (d)	57. (b)	58. (c)	59. (d)	60. (c)
61. (c)	62. (a)	63. (a)	64. (c)	65. (c)	66. (a)	67. (d)	68. (b)	69. (c)	70. (d)
71. (b)	72. (b)	73. (a)							

Explanations

1. (c) Plant growth is indeterminate, i.e. plants can grow throughout their life due to the presence of meristematic tissue. The cell elongation phase is characterised by increased vacuolation, helping cells expand. Meristematic cells are rich in plasmodesmatal connections for nutrient and signal transport. Plant growth is measurable through various parameters like height, biomass, and leaf area.

2. (d) Log phase or exponential phase is the period of rapid growth of plant. There is a significant increase in the number of cells which results in an increase of height and biomass.

3. (c) S - Shaped or sigmoid growth curve is exhibited by numerous annual plants. It consists of 3 phases, lag phase (slow), log phase (exponential) and steady phase. It is typical for all cells.

4. (c) Opening of floral bud: autonomic movement of growth (nastic movement).

5. (b) Exponential growth is shown by cells that are doubling with respect to time in a constant manner. A cell in tissue culture follows up this type of growth unless it becomes an embryo.

6. (a) Phytotron provides all services that are necessary to conduct many types of controlled environment experiments to study the growth of plants.

7. (b) Klinostat is a device used in experiments to test the influence of gravity on growth movements.

8. (c) The living differentiated cells, that by now have lost the capacity to divide, can regain the capacity of division under certain conditions. This phenomenon is termed as dedifferentiation. Same occurs in tissue culture of leaf.

9. (d) The ability of plants to follow different pathways in response to environmental cues leading to the formation of diverse structures is known as plasticity. This characteristic allows plants to adapt to varying environmental conditions.

10. (c) The phenomenon by which the undividing parenchyma cells start to divide mitotically during plant tissue culture is called dedifferentiation. This process involves mature cells reverting to a less specialized state, enabling them to divide again.

11. (a) Plants follow different pathways in response to environment or phases of life to form different kinds of structures. This ability is called plasticity. It can be observed in cotton, coriander and buttercup.

12. (b) Plasticity is the ability of the plants through which they follow different pathways in response to the environment or phases of life to form different kinds of structures.

13. (d) Decapitation of plants leads to the activation of axillary buds due to increase in cytokinin and shoots are able to continue normal growth & development.

14. (c) Spraying of gibberellins on juvenile conifers, hastens the maturity period and thus leading to early seed production.

15. (d) Ethylene promotes rapid internode/petiole elongation in deep water rice plants.

16. (a) Phototropism

Phototropism is the growth of a plant in response to light, which was instrumental in the discovery of auxin. Auxin was isolated by F.W. Went from tips of coleoptiles of Oat seedlings.

17. (b) (A)-(IV), (B)-(III), (C)-(II), D-(I)

Auxin - Promotes flowering in pineapple

Gibberellin - Increase in the length of grape stalks

Cytokinin - Overcoming apical dominance

Ethylene - Promotes female flower formation in cucumber

18. (c) Cytokinin is a class of growth regulators that are adenine derivatives. Cytokinin will help in the division of the cell.

19. **(d)** Ethylene is a simple gaseous PGR. It is synthesised in large amounts by tissues undergoing senescence and ripening fruits. It promotes female flowers in cucumbers thereby increasing the yield.

20. **(c)** Auxins are widely used as herbicides and therefore can kill dicotyledonous weeds in the fields.
Gibberellic acid is used to speed up the malting process in brewing industry.
Cytokinins help overcome the apical dominance.
Ethylene promotes root growth and root hair formation, thus helping the plants to increase their absorption surface.

21. **(b)** 2,4-D is a synthetic auxin which is widely used to destroy dicotyledonous weeds.
IAA and IBA are natural auxins. NAA is a synthetic auxin.

22. **(a)** Sugarcane stores carbohydrate as sugar in their stems. Spraying sugarcane crop with gibberellins increases the length of the stem, thus increasing the yield by as much as 20 tonnes per acre.

23. **(b)** Ethylene is highly effective in fruit ripening. Auxins are widely used as herbicides. 2, 4-D, widely used to kill dicotyledonous weeds, does not affect mature monocotyledonous plants. Gibberellins promotes bolting (internode elongation just prior to flowering) in beet, cabbages and many plants with rosette habit. ABA stimulates the closure of stomata in the epidermis and increases the tolerance of plants to various kinds of stresses. Therefore, it is also called the stress hormone.

24. **(d)** Skoog and Miller, later identified and crystallised the cytokinesis promoting active substance and they termed it as kinetin.

25. **(a)** Plant hormone, auxin, induces flowering in pineapple. Ethylene is used in synchronization of flowering and fruit set up in pineapple.

26. **(c)** Auxins prevent premature leaf and fruit fall.
NAA prevents fruit drop in tomato; 2,4-D prevents fruit drop in *Citrus*.

27. **(d)** Auxin helps in the formation of roots and cytokinin helps in the formation of shoots.

28. **(c)** Bioassay means the testing of substance for its activity in causing a growth response in a living plant or its part. The Avena curvature test and root growth inhibition test are some of the bioassays for examining auxin activity.

29. **(b)** Auxin synthesis occurs rapidly in greater amount in green leaves in the presence of light than in dark. Translocations of auxin is polar.

30. **(d)** Avena curvature test is based on the findings that the curvature produced in 0° at coleoptile is determined by the auxin concentration in an agar block. 10° curvature is produced by auxin concentration of 150 g/L.

31. **(b)** This experiment made possible the isolation and exact identification of auxin.

32. **(b)** ABA increases the plants tolerance to various kinds of stresses.

33. **(a)** Gibberellin induces aleurone cells to secrete enzyme to break stored food in seed.

34. **(c)** ABA: Abscisic acid also known as anti-gibberellic acid.

35. **(c)** IAA exhibits apical dominance. Removal of shoot tips usually results in the growth of lateral buds. It is widely applied in tea plantations.

36. **(c)** Senescence as an active developmental cellular process in the growth and functioning of flowering plants is indicated in leaf abscission. Senescence is the changes that occur in an organism between maturity and death, i.e., ageing. Characteristically, there is deterioration in functioning as the cells become less efficient in maintaining and replacing vital cells components.

37. **(d)** Gibberellic acid delays senescence.

38. **(c)** Pruning helps in overcoming apical dominance.

39. **(b)** Parthenocarpic tomato fruits can be produced by treating the plant with low concentration of gibberellic acid (promotes fruit set) and auxin (completes the development process).

40. **(d)** Auxin help to initiate rooting in stem cutting.

41. **(b)** Gibberellins are the phytohormones that promote germination, stem elongation, and leaf development. It also influences processes like dormancy, sex expression, enzyme induction and leaf & fruit senescence.

42. **(b)** Auxin & cytokinin (phytohormones) ratio have an effect on differentiation of root or shoot in callus. A high ratio of cytokinin to auxin favours shoot production, whereas a high auxin to cytokinin ratio favours root production.

43. **(d)** Cytokinins are a class of plant growth hormones that promote cell division or cytokinesis. A major cytokinin is found in coconut milk. Cytokinins in coconut milk have various functions in association with other hormones or its accessories.

44. **(a)** Gibberellins are produced in greater mass when the plant is exposed to cold temperatures. They stimulate cell elongation & seed germination by breaking the seed's dormancy.

45. **(a)** ABA (Abscisic acid) owes its name to its role in abscission of plant leaves. ABA slows plant growth & promote senescence.

46. **(b)** Naphthyl Acetic Acid is a plant hormone used to induce flowering, to prevent shedding of buds, flowers & unripe fruits and to increase the yield & quality of fruits.

47. **(a)** Ethylene serves as a phytohormone that acts at trace levels throughout the life of the plant by regulating & stimulating the fruit ripening, opening of flowers and shedding of leaves.

48. **(a)** The end of a shoot contains an apical bud, which is the location where shoot growth occurs. Apical bud produces IAA (an auxin) that inhibits growth of the lateral buds called apical dominance.

49. **(a)** Hormone ethylene stimulates the ripening of fruits.

50. **(b)** Ratio of auxin to cytokinin plays an important role in morphogenesis during plant growth. Cytokinins promote cell division and differentiation of young, relatively unspecialized cells into mature, more specialized cells in intact plants (morphogenesis).

51. **(b)** AMO - 1618 is an anti - gibberellin which is used in biological war for destruction of plants due to its weedicide properties.

52. **(d)** Gibberellic acids (GA) regulate flower initiation & its development. Introduction of GA can lead to flowering in long day plants even under the short day conditions.

53. **(b)** Auxin moves from the root & shoot apices to the basal region of the plant, this type of movement is called basipetal movement.

54. **(d)** End of shoot contains an apical bud, which is the location where shoot growth occurs. Apical bud produces auxin that inhibits the growth of lateral buds, so when apical bud is removed lateral branching starts.

55. **(a)** Cytokinin, a plant growth hormone, promotes cytokinesis & retards & delay senescence in plants. It also has anti-aging effects in human skin cells.

56. **(d)** Abscisic acid is produced under stress conditions such as drought & promote dormancy of seed during such conditions.

57. **(b)** Abscisic acid is a stress hormone in plants & is produced to ensure the survival of plants even under the stressful condition & induce certain adaptations.

58. **(c)** Ascorbic acid (vitamin-C) prevents over ripening of banana and other fruits because it is an antioxidant.

59. **(d)** The phenomenon where the main central stem of the plant is dominant over other side stems is called apical dominance. Apical bud at shoot tip produces auxin that inhibits the growth of side stems & contribute to apical dominance.

60. **(c)** Retention of chlorophyll is induced by cytokinin hormone. Cytokinins delay senescence & keep chloroplasts photosynthetically active.

61. **(c)** Hormone ethylene majorly contributes to ripening of fruits in plants. This hormone is, therefore, used to artificially ripen the fruits.

62. **(a)** ABA (Abscisic acid) rapidly alters the osmotic potential of stomatal guard cells, causing them to shrink and stomata to close.

63. **(a)** Plant hormone auxin is produced by apical bud to inhibits the growth of lateral stems and promote apical dominance.

64. **(c)** Florigen is synthesised in the leaves under favourable photoperiodic conditions. This hormone is transmitted to the growing point where the flowering occurs.

65. **(c)** Cytokinin plays a major role in promoting the cell division or cytokinesis and stimulating the plant growth.

66. **(a)** Growing apex having meristematic cells is the site where endogenous auxins are present in sufficient amount, once the apex is removed the source of auxins is also removed.

67. **(d)** Phytohormones regulate the growth of plants. These are signal molecules produced in low concentrations within the plants.

68. **(b)** ABA plays a role in abscission of plant leaves & slows down plant growth. It functions in dormancy too.

69. **(c)** Nyctinasty is circadian rhythmic nastic movement in response to onset of darkness, e.g., sleep movements of the leaves of many legumes.

70. **(d)** Cytokinins delay senescence of leaves and other organs by mobilisation of nutrients.

71. **(b)** Because of removal of apical dominance and stimulation of intercalary meristem.

72. **(b)** Cytokinins are plant growth hormones which are basic in nature. Cytokinins induce formation of new leaves and chloroplasts in leaves.

73. **(a)** Gibberellins are involved in the natural process of breaking dormancy & other aspects of germination. They stimulate cell elongation, budding and seed germination.

CHAPTER 14

Breathing and Exchange of Gases

Respiratory Organs

1. Which is incorrect? *(2006)*
   a. Presence of non-respiratory air sacs increases efficiency of respiration in birds.
   b. In insects, circulating body fluids serve to distribute oxygen to tissues.
   c. Principle of counter-current flow facilitates efficient respiration in gills at fishes.
   d. Residual air in lungs slightly decreases the efficiency of respiration in mammals

2. Given below are four matchings of an animal and its kind of respiratory organ: [OS] *(2003)*
   A. Silver fish – Trachea
   B. Scorpion – Book lung
   C. Sea squirt –Pharyngeal gills
   D. Dolphin – Skin
   The correct matchings are:-
   a. A and D b. A, B and C
   c. B and D d. C and D

3. Skin is an accessory organ of respiration in: *(1990)*
   a. Humans b. Frog
   c. Rabbit d. Lizard

Human Respiratory System

4. Select the sequence of steps in Respiration. [MR*] *(2023-Manipur)*
   A. Diffusion of gases (O_2 and CO_2) across alveolar membrane.
   B. Diffusion of O_2 and CO_2 between blood and tissues.
   C. Transport of gases by the blood.
   D. Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.
   E. Utilisation of O_2 by the cells for catabolic reactions and resultant release of CO_2.
   Choose the correct answer from the options given below:
   a. (D), (A), (C), (B), (E) b. (C), (B), (A), (E), (D)
   c. (B), (C), (E), (D), (A) d. (A), (C), (B), (E), (D)

5. Haemoglobin of human foetus: [OS] *(200…*
   a. Has two protein subunits instead of four
   b. Has higher affinity of oxygen than that of the adult
   c. Has lower affinity of oxygen than that of the adult
   d. Its affinity for oxygen is the same as that of an adult

6. Lungs are enclosed in: *(199…*
   a. Periosteum b. Perichondrium
   c. Pericardium d. Pleural membrane

7. In man and mammals, air passes from outside into the lungs through: *(1994)*
   a. Nasal cavity, larynx, pharynx, trachea, bronchi, alveoli
   b. Nasal cavity, larynx, pharynx, trachea, bronchioles, alveoli
   c. Nasal cavity, pharynx, larynx, trachea, bronchioles, bronchi, alveoli
   d. Nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, alveoli

Mechanism of Breathing

8. Select the correct events that occur during inspiration [MR*] *(2020)*
   1. Contraction of diaphragm
   2. Contraction of external inter-costal muscles
   3. Pulmonary volume decreases
   4. Intra pulmonary pressure increases
   a. (3) and (4) b. (1), (2) and (4)
   c. Only (4) d. (1) and (2)

9. Lungs do not collapse between breaths and some air always remains in the lungs which can never be expelled because: *(2016 - II)*
   a. There is a positive intrapleural pressure
   b. Pressure in the lungs is higher than the atmospheric pressure.
   c. There is a negative pressure in the lungs.
   d. There is a negative intrapleural pressure pulling at the lung walls

10. Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort? *(2011 Mains)*
    a. One can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all
    b. The lungs can be made fully empty by forcefully breathing out all air from them
    c. One can breathe out air totally without oxygen
    d. One can breathe out air through Eustachian tubes by closing both the nose and the mouth

11. The ventilation movements of the lungs in mammals are governed by: *(1995)*
    a. Muscular walls of lung b. Diaphragm
    c. Coastal muscles d. Both (b) and (c)

12. Intercostal muscles occur in: *(1988)*
    a. Abdomen b. Thigh
    c. Ribs d. Diaphragm

Respiratory Volumes & Capacities

13. Vital capacity of lung is _____. *(2023)*
    a. IRV + ERV + TV b. IRV + ERV
    c. IRV + ERV + TV + RV d. IRV + ERV + TV – RV

14. Which of the following statements are correct with respect to vital capacity? [MR*] *(2022 Re)*
    A. It includes ERV, TV and IRV.
    B. Total volume of air a person can inspire after a normal expiration.
    C. The maximum volume of air a person can breathe in after forced expiration.
    D. It includes ERV, RV and IRV.
    E. The maximum volume of air a person can breathe out after a forced inspiration.
    Choose the most appropriate answer from the options given below.
    a. (A) and (E) b. (B), (D) and (E)
    c. (A), (C) and (D) d. (A), (C) and (E)

15. The Total Lung Capacity (TLC) is the total volume of air accommodated in the lungs at the end of a forced inspiration. This includes: *(2020-Covid)*
    a. RV; ERV; IC and EC
    b. RV; ERV; VC (Vital Capacity) and FRC (Functional Residual Capacity)
    c. RV (Residual volume); ERV (Expiratory Reserve Volume); TV (Tidal Volume); and IRV (Inspiratory Reserve Volume)
    d. RV; IC (Inspiratory Capacity); EC (Expiratory Capacity); and ERV

16. Tidal Volume and Expiratory Reserve Volume of an athlete is 500 mL and 1000 mL, respectively. What will be his Expiratory Capacity if the Residual Volume is 1200 mL? *(2019)*
    a. 1500 mL b. 1700 mL

17. Match the items given Column I with those in Column II and select the correct option given below [MR*] *(2018)*

	Column I		Column II
A.	Tidal volume	i.	2500-3000 mL
B.	Inspiratory Reserve volume	ii.	1100-1200 mL
C.	Expiratory Reserve volume	iii	500-550 mL
D.	Residual volume	iv	1000-1100 mL

    a. A-iii B-ii C-i D-iv
    b. A-iii B-i C-iv D-ii
    c. A-i B-iv C-ii D-iii
    d. A-iv B-iii C-ii D-i

18. Lungs are made up of air-filled sacs the alveoli. They do not collapse even after forceful expiration, because of: *(2017-Delhi)*
    a. Residual Volume b. Inspiratory Reserve Volume
    c. Tidal Volume d. Expiratory Reserve Volume

19. Listed below are four respiratory capacities (A-D) and four jumbled respiratory volumes of a normal human adult: *(2010 Pre)*

	Respiratory capacities	Respiratory volumes
A.	Residual volume	2500 mL
B.	Vital capacity	3500 mL
C.	Inspiratory reserve volume	1200 mL
D.	Inspiratory capacity	4500 mL

    Which one is correct matching?
    a. (C) 1200 mL, (D) 2500 mL
    b. (D) 3500 mL, (A) 1200 mL
    c. (A) 4500 mL, (B) 3500 mL
    d. (B) 2500 mL, (C) 4500 mL

20. Vital capacity of lungs is: *(2008)*
    a. Inspiratory reserve volume plus expiratory reserve volume
    b. Inspiratory reserve volume plus tidal volume
    c. Total lung capacity minus expiratory reserve volume
    d. Total lung capacity minus residual volume

21. When 1500 ml air is in the lungs, it is called: *(1996)*
    a. Residual volume b. Inspiratory reserve volume
    c. Vital capacity d. Tidal volume

Exchange and Transport of Gases

22. Select the favourable conditions required for the formation of oxyhaemoglobin at the alveoli. *(2021)*
    a. Low pO_2, high pCO_2, more H^+, higher temperature
    b. High pO_2, high pCO_2, less H^+, higher temperature
    c. Low pO_2, low pCO_2, more H^+, higher temperature
    d. High pO_2, low pCO_2, less H^+, lower temperature

23. The partial pressures (in mm Hg) of oxygen (O_2) and carbon dioxide (CO_2) at alveoli (the site of diffusion) are: *(2021)*
a. pO_2 = 40 and pCO_2 = 45
b. pO_2 = 95 and pCO_2 = 40
c. pO_2 = 159 and pCO_2 = 0.3
d. pO_2 = 104 and pCO_2 = 40

24. Identify the wrong statement with reference to transport of oxygen [MR*] *(2020)*
a. Partial pressure of CO_2 can interfere with O_2 binding with haemoglobin.
b. Higher H^+ conc. in alveoli favours the formation of oxyhaemoglobin.
c. Low pCO_2 in alveoli favours the formation of oxyhaemoglobin.
d. Binding of oxygen with haemoglobin is mainly related to partial pressure of O_2.

25. The partial pressure of oxygen in the alveoli of the lungs is: *(2016 - II)*
a. Less than that in the blood
b. Less than that of carbon dioxide
c. Equal to that in the blood
d. More than that in the blood

26. Reduction in pH of blood will: *(2016 - I)*
a. Reduce the rate of heart beat
b. Reduce the blood supply to the brain
c. Decrease the affinity of hemoglobin with oxygen
d. Release bicarbonate ions by the liver

27. When you hold your breath, which of the following gas changes in blood would first lead to the urge to breathe? *(2015 Re)*
a. Rising CO_2 concentration
b. Rising CO_2 and falling O_2 concentration
c. Falling O_2 concentration
d. Falling CO_2 concentration

28. Approximately seventy percent of carbon-dioxide absorbed by the blood will be transported to the lungs: *(2014)*
a. As carbamino-haemoglobin
b. As bicarbonate ions
c. In the form of dissolved gas molecules
d. By binding to R.B.C.

29. Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as: *(2011 Mains)*
a. 70% carbamino-haemoglobin and 30% as bicarbonate
b. Carbamino-haemoglobin in RBCs
c. Bicarbonate in blood plasma and RBCs
d. Free CO_2 in blood plasma

30. A large proportion of oxygen is left unused the human blood even after its uptake by the body tissues. This O_2: *(2011 Pre)*
a. Helps in releasing more O_2 to the epithelium tissues
b. Acts as a reserve during muscular exercise
c. Raises the pCO_2 of blood to 75 mm of Hg
d. Is enough to keep oxyhaemoglobin saturation at 96%

31. The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function? *(2011 Pre)*

a. B: Red blood cell - Transport of CO_2 mainly
b. C: Arterial capillary - Passes oxygen to tissues
c. A: Alveolar cavity - Main site of exchange of respiratory gases
d. D: Capillary wall - Exchange of O_2 and CO_2 takes place here

32. What is true about RBCs in human? *(2010 Pre)*
a. They transport 99.5% of O_2
b. They transport 80% oxygen, the rest 20% being transported by plasma
c. They do not carry CO_2 at all
d. They carry 20-25% of CO_2

33. Majority of CO_2 produced by our body cells is transported to lungs: *(2006)*
a. Attached to haemoglobin b. Dissolved in blood
c. As bicarbonates d. As carbonates

34. Blood analysis of a patient reveals an unusually high quantity of carboxy-haemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing unusually high content of: *(2004)*
a. Chloroform b. Carbon dioxide
c. Carbon monoxide d. Carbon disulphide

35. When CO_2 concentration in blood increases; breathing becomes: *(2004)*
a. There is no effect on breathing
b. Slow and deep
c. Faster and deeper
d. Shallower and slow

36. Exchange of bicarbonates and chloride ions between RBC and plasma is called: *(1999)*
a. Chloride shift b. Bohr's effect
c. Haldane's effect d. Intracellular respiration

37. Transport of gases in alveoli takes place by: *(1998)*
a. Active transport b. Passive transport
c. Simple diffusion d. None

38. CO is harmful because: *(1998)*
a. It forms stable compound with hemoglobin
b. It blocks mitosis
c. It is mutagenic
d. It causes defoliation

39. In lungs, the air is separated from the venous blood through: [OS] *(1997)*
a. Transitional epithelium + tunica externa of blood vessel
b. Squamous epithelium + endothelium of blood vessel
c. Squamous epithelium + tunica media of blood vessel
d. None of the above

40. How the transport of O_2 and CO_2 by blood happens? *(1996)*
a. With the help of WBCs and blood serum
b. With the help of platelets and corpuscles
c. With the help of RBCs and blood plasma
d. With the help of RBCs and WBCs

41. Although much CO_2 is carried in blood, yet blood does not become acidic, because: *(1995)*
a. CO_2 is continuously diffused through the tissues and is not allowed to accumulate
b. In CO_2 transport, blood buffers play an important role
c. CO_2 is absorbed by the leucocytes
d. CO_2 combines with water to form H_2CO_3 which is neutralized by $NaCO_3$

42. The carbon dioxide transported *via* blood to lungs mostly: *(1995)*
a. In combination with heamoglobin only
b. Dissolved in blood plasma
c. In the form of bicarbonate ions
d. As carbaminohaemoglobin and as carbonic acid

43. Carbon dioxide is transported from tissues to respiratory surface by only: *(1993)*
a. Plasma and erythrocytes b. Plasma
c. Erythrocytes d. Erythrocytes and leucocytes

44. The alveolar epithelium in the lung is: *(1990)*
a. Non-ciliated columnar b. Non-ciliated squamous
c. Ciliated columnar d. Ciliated squamous

Regulation & Disorders of Respiratory System

45. Match the following columns and select the correct option: [MR*] *(2020-Covid)*

	Column-I		Column-II
1.	Pneumotaxic Centre	(i)	Alveoli
2.	O_2 Dissociation curve	(ii)	Pons region of brain
3.	Carbonic Anhydrase	(iii)	Haemoglobin
4.	Primary site of exchange of gases	(iv)	R.B.C.

	(1)	(2)	(3)	(4)
a.	(ii)	(iii)	(iv)	(i)
b.	(iii)	(ii)	(iv)	(i)
c.	(iv)	(i)	(iii)	(ii)
d.	(i)	(iii)	(ii)	(iv)

46. Due to increasing air-borne allergens and pollutants, many people in urban areas are suffering from respiratory disorder causing wheezing due to *(2019)*
a. Benign growth on mucous lining of nasal cavity
b. Inflammation of bronchi and bronchioles
c. Proliferation of fibrous tissues and damage of the alveolar walls
d. Reduction in the secretion of surfactants by pneumocytes.

47. Which of the following options correctly represents the lung conditions in asthma and emphysema, respectively? [MR*] *(2018)*
a. Inflammation of bronchioles; Decreased respiratory surface
b. Increased number of bronchioles; Increased respiratory surface
c. Increased respiratory surface; Inflammation of bronchioles
d. Decreased respiratory surface; Inflammation of bronchioles

48. Which of the following is an occupational respiratory disorder? *(2018)*
a. Anthracis b. Silicosis
c. Botulism d. Emphysema

49. Asthma may be attributed to: *(2016 - I)*
a. Bacterial infection of the lungs
b. Allergic reaction of the mast cells in the lungs
c. Inflammation of the trachea
d. Accumulation of fluid in the lungs

50. Name the chronic respiratory disorder caused mainly by cigarette smoking: *(2016 - I)*
a. Emphysema b. Asthma
c. Respiratory acidosis d. Respiratory alkalosis

51. Name the pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls. *(2015 Re)*
a. Emphysema b. Pneumonia
c. Asthma d. Pleurisy

52. Which one of the following is the correct statement for respiration in humans? [MR*] *(2012 Pre)*
a. About 90% of carbon dioxide (CO_2) is carried by haemoglobin as carbamino-haemoglobin
b. Cigarette smoking may lead to inflammation of bronchi
c. Neural signals from pneumotoxic centre in pons region of brain can increase the duration of inspiration
d. Workers in grinding and stone-breaking industries may suffer from lung fibrosis.

53. Deficiency of oxygen affects most the: *(1999)*
a. Brain b. Skin
c. Kidney d. Intestine

54. The respiratory centre which regulates respiration is located in: *(1994)*
a. Cerebellum b. Medulla oblongata
c. Cerebral peduncle d. The vagus nerve

Scanned with OKEN Scanner

Nearly 70 per cent of carbon dioxide is transported by RBCs as bicarbonate (HCO_3) with the help of the enzyme carbonic anhydrase.

A sigmoid curve is obtained when percentage saturation of haemoglobin with O_2 is plotted against the pO_2. This curve is called the Oxygen dissociation curve .

46. **(b)** Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. It can be due to increasing air-borne allergens and pollutants. Many people in urban areas are suffering from this respiratory disorder.

47. **(a)** Asthma is a chronic lung disease that inflames and narrows the airways. It is the result of chronic inflammation of conducting zone of airways, especially the bronchi and bronchioles. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.

48. **(b)** Silicosis is caused by inhalation of dust containing silica. It is a form of occupational lung disease.

49. **(b)** Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. Asthma symptoms can be produced by sensitized mast cells degranulation.

50. **(a)** Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major causes of this is cigarette smoking.

51. **(a)** Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. Cigarette smoking is the major cause.

52. **(d)** In certain industries, especially those involving grinding or stone-breaking, so much dust is produced that the defense mechanism of the body cannot fully cope with the situation. Long exposure can give rise to inflammation leading to lung fibrosis (proliferation of fibrous tissues).

Alveolar walls are damaged by cigarette smoking. CO_2 is carried by haemoglobin as carbamino-haemoglobin (about 20-25 per cent).

Neural signals from the pneumotaxic centre in pons region of brain can reduce the duration of inspiration and thereby alter the respiratory rate.

53. **(a)** During oxygen deprivation, cells die due to an increasing acidity in the brain tissue. Brain injury, stroke, carbon monoxide poisoning are possible causes of hypoxia.

54. **(b)** A specialised centre present in medulla region of brain called respiratory rhythm centre is primarily responsible for the regulation of respiration.

CHAPTER 15

Body Fluids and Circulation

Blood and Lymph

1. Which of the following statements are correct? *(2023)*

A. Basophils are most abundant cell of the total WBCs
B. Basophils secrete histamine, serotonin and heparin
C. Basophils are involved in inflammatory response
D. Basophils have kidney shaped nucleus
E. Basophils are agranulocyte

Choose the correct answer from the options given below:

a. A and B only
b. D and E only
c. C and E only
d. B and C only

2. Match **List-I** with **List-II**. [MR°] *(2023-Manipur)*

	List-I		List-II
(A)	Eosinophils	(I)	6 – 8%
(B)	Lymphocytes	(II)	2 – 3%
(C)	Neutrophils	(III)	20 – 25%
(D)	Monocytes	(IV)	60 – 65%

Choose the **correct** answer from the options given below:

a. A-IV, B-I, C-II, D-III
b. A-IV, B-I, C-III, D-II
c. A-II, B-III, C-IV, D-I
d. A-II, B-III, C-I, D-IV

3. Arrange the following formed elements in the decreasing order of their abundance in blood in humans: *(2022 Re)*

(a) Platelets
(b) Neutrophils
(c) Erythrocytes
(d) Eosinophils
(e) Monocytes

Choose the most appropriate answer from the options given below:

a. (a), (c), (b), (d), (e)
b. (c), (a), (b), (e), (d)
c. (c), (b), (a), (e), (d)
d. (d), (e), (b), (a), (c)

4. Given below are two statements: *(2022)*

Statement I: The coagulum is formed of network of threads called thrombins

Statement II: Spleen is the graveyard of erythrocytes

In the light of the above statements, choose the most appropriate answer from the options given below.

a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both statement I and statement II are incorrect
d. Statement I is correct but Statement II is incorrect

5. Which enzyme is responsible for the conversion of inactive fibrinogens to fibrins? *(2021)*

a. Renin
b. Epinephrine
c. Thrombokinase
d. Thrombin

6. Persons with 'AB' blood group are called as "Universal recipients". This is due to: *(2021)*

a. Absence of antigens A and B in plasma
b. Presence of antibodies, anti-A and anti-B, on RBCs
c. Absence of antibodies, anti-A and anti-B, in plasma
d. Absence of antigens A and B on the surface of RBCs

7. Match the following columns and select the correct option [MR°] *(2020)*

	Column - I		Column - II
1.	Eosinophils	(i)	Immune response
2.	Basophils	(ii)	Phagocytosis
3.	Neutrophils	(iii)	Release histaminase, destructive enzymes
4.	Lymphocytes	(iv)	Release granules containing histamine

	(1)	(2)	(3)	(4)
a.	(iv)	(i)	(ii)	(iii)
b.	(i)	(ii)	(iv)	(iii)
c.	(ii)	(i)	(iii)	(iv)
d.	(iii)	(iv)	(ii)	(i)

8. Which of the following conditions cause erythroblastosis foetalis? *(2020-Covid)*

a. Mother Rh^{-ve} and foetus Rh^{-ve}
b. Both mother and foetus Rh^{-ve}
c. Both mother and foetus Rh^{+ve}
d. Mother Rh^{+ve} and foetus Rh^{-ve}

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9. Match the items given in Column I with those in Column II and select the correct option given below [MR*] *(2018)*

	Column I		Column II
A.	Fibrinogen	i.	Osmotic balance
B.	Globulin	ii.	Blood clotting
C.	Albumin	iii.	Defence mechanism

a. A-iii B-ii C-i
b. A-i B-ii C-iii
c. A-i B-iii C-ii
d. A-ii B-iii C-i

10. Adult human RBCs are enucleate. Which of the following statement(s) is/are most appropriate explanation for this feature? *(2017-Delhi)*

A. They do not need to reproduce
B. They are somatic cells
C. They do not metabolise
D. All their internal space is available for oxygen transport

a. Only (D) b. Only (A)
c. (A), (C) and (D) d. (B) and (C)

11. Serum differs from blood in: *(2016 - II)*

a. Lacking clotting factors b. Lacking antibodies
c. Lacking globulins d. Lacking albumins

12. Name the blood cells, whose reduction in number can cause clotting disorder, leading to excessive loss of blood from the body. *(2016 - II)*

a. Neutrophils b. Thrombocytes
c. Erythrocytes d. Leukocytes

13. Which one of the following is correct? [MR*] *(2015)*

a. Lymph = Plasma + RBC + WBC
b. Blood = Plasma + RBC + WBC + Platelets
c. Plasma = Blood – Lymphocytes
d. Serum = Blood + Fibrinogen

14. Erythropoiesis starts in: *(2015)*

a. Spleen b. Red bone marrow
c. Kidney d. Liver

15. If you suspect major deficiency of antibodies in a person, to which of the following would you look for confirmatory evidences? *(2015 Re)*

a. Serum albumins b. Haemocytes
c. Serum globulins d. Fibrinogen in plasma

16. Person with blood group AB is considered as universal recipient because he has: *(2014)*

a. Both A and B antigens in the plasma but no antibodies
b. Both A and B antigens on RBC but no antibodies in the plasma
c. Both A and B antibodies in the plasma
d. No antigen on RBC and no antibody in the plasma

17. The most abundant intracellular cation is: [OS] *(2013)*

a. K^+ b. Na^+
c. Ca^{++} d. H^+

18. A certain road accident patient with unknown blood group needs immediate blood transfusion. His one doctor friend at once offers his blood. What was the blood group of the donor? *(2012 Pre)*

a. Blood group A b. Blood group B
c. Blood group AB d. Blood group O

19. Which one of the following human organs is often called the "graveyard" of RBCs? *(2012 Mains)*

a. Gall bladder b. Kidney
c. Spleen d. Liver

20. A person with unknown blood group under ABO system has suffered much blood loss in an accident and needs immediate blood transfusion. His one friend, who has a valid certificate of his own blood type, offers for blood donation without delay. What would have been the type of blood group of the donor friend? *(2011 Pre)*

a. Type A b. Type B
c. Type AB d. Type O

21. Which one of the following plasma proteins is involved in the coagulation of blood? *(2011 Pre)*

a. Fibrinogen b. An albumin
c. Serum amylase d. A globulin

22. Globulins contained in human blood plasma are primarily involved in: *(2006)*

a. Clotting of blood
b. Osmotic balance of body fluids
c. Defense mechanism of body
d. Oxygen transport in blood

23. Human blood grouping is ABO instead of ABC because O in it refers to: *(2009)*

a. No antigen A or B on RBCs
b. Other antigens besides A and B
c. Over-dominance of its gene over A and B
d. One antibody only either anti-A or anti -B

24. Most active phagocytic white blood cells are: *(2008)*

a. Lymphocytes and macrophages
b. Neutrophils and eosinophils
c. Eosinophils and lymphocytes
d. Neutrophils and monocytes

25. Which leukocytes release histamine and heparin? *(2008)*

a. Eosinophils b. Basophils
c. Monocytes d. Neutrophils

26. Which will not coagulate? *(2007)*

a. Blood serum b. Blood plasma
c. Lymph d. Whole blood

27. Which one of the following substances, if introduced in blood stream would cause coagulation of blood at the site of its introduction? *(2005)*

a. Prothrombin b. Fibrinogen
c. Thromboplastin d. Heparin

28. You are required to draw blood from a patient and to keep it in a test tube for analysis of blood corpuscles and plasma. You are also provided with the following four types of test tubes. Which of them will you not use for the purpose? *(2004)*

a. Chilled test tube
b. Test tube containing heparin
c. Test tube containing sodium oxalate
d. Test tube containing calcium bicarbonate

29. Continuous bleeding from an injured part of body is due to deficiency of: [OS] *(2002)*

a. Vitamin-A b. Vitamin -B
c. Vitamin-K d. Vitamin-E

30. Which of the following statement is true for lymph? *(2002)*

a. WBC and serum
b. All components of blood except RBCs and some proteins
c. RBCs, WBCs and Plasma
d. RBCs, Proteins and Platelets

31. What is correct for blood group 'O'? *(2001)*

a. No antigens but both *A* and *B* antibodies are present
b. A Antigen and B antibody
c. Antigen and Antibody both absent
d. A and B antigens and *A*, *B*, antibodies

32. Erythroblastosis foetalis is caused when

a. Rh^- female & Rh^+ male
b. Rh^+ female & Rh^+ male
c. Rh^- female & Rh^- male
d. Rh^+ female & Rh^- male

33. Which statement is true for WBC?

a. Non-nucleated
b. In deficiency cancer is caused
c. Manufactured in thymus
d. Can squeeze through blood capillaries

34. Which of following occurs in maximum concentration in blood plasma (ECF)? [OS] *(1999)*

a. K^+ b. Mg^{2+}
c. Ca^{2+} d. Na^+

35. Agglutination occurs in blood present in a test tube. This indicate: *(1999)*

a. Antibodies are present in plasma
b. Antigens are present on R.B.C.
c. Antigens are present in plasma
d. Antibodies are present on R.B.C

36. Which of the following is agranulocyte? *(1997)*

a. Basophil b. Neutrophil
c. Lymphocyte d. Eosinophil

37. The life span of human WBC is approximately: *(1997)*

a. Between 2 to 3 months b. More than 4 months
c. Less than 10 days d. Between 20 to 30 days

38. The lymph serves to: *(1995)*

a. Return the interstitial fluid to the blood
b. Return the WBCs and RBCs to the lymph nodes
c. Transport CO_2 to the lungs
d. Transport O_2 to the brain

39. The haemorrhagic disease of new born is caused due to the deficiency of: [OS] *(1995)*

a. Vitamin K b. Vitamin B_{12}
c. Vitamin A d. Vitamin B_1

40. Vitamin K is required for: [OS] *(1993)*

a. Change of prothrombin into thrombin
b. Synthesis of prothrombin
c. Change of fibrinogen to fibrin
d. Formation of thromboplastin

41. Cells formed in bone marrow include: *(1992)*

a. RBC b. RBC and leucocytes
c. Leucocytes d. Lymphocytes

42. Component of blood responsible for producing antibodies is: *(1992)*

a. Thrombocytes b. Monocytes
c. Erythrocytes d. Lymphocytes

43. Blood group AB has: *(1991)*

a. No antigen
b. No antibody
c. Neither antigen nor antibody
d. Both antigen and antibody

44. A person with blood group A required blood. The blood group which can be given is: *(1989)*

a. A and B b. A and AB
c. A and O d. A, B, AB and O

45. Lymph differs from blood in possessing: *(1989)*

a. Only WBC
b. More RBC and WBC
c. More RBC and few WBC
d. More WBC and few RBC

46. Child death may occur in the marriage of: *(1988)*

a. Rh^+ man and Rh^+ woman
b. Rh^+ man and Rh^- woman
c. Rh^- man and Rh^- woman
d. Rh^- man and Rh^+ woman

47. Breakdown product of haemoglobin is: *(1988)*

a. Bilirubin b. Iron
c. Biliverdin d. Calcium

48. RBCs do not occur in: *(1988)*

a. Frog b. Cow
c. Camel d. Cockroach

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Circulatory Pathways

49. Match List-I with List-II. *(2023)*

List-I		List-II	
(A)	P-wave	(I)	Beginning of systole
(B)	Q-wave	(II)	Repolarisation of ventricles
(C)	QRS complex	(III)	Depolarisation of atria
(D)	T-wave	(IV)	Depolarisation of ventricles

a. A-I, B-II, C-III, D-IV
b. A-III, B-I, C-IV, D-II
c. A-IV, B-III, C-II, D-I
d. A-II, B-IV, C-I, D-III

50. Match List-I with List-II. [MR^3] *(2023-Manipur)*

List-I (ECG)		List-II (Electrical activity of heart)	
(A)	P-wave	(I)	Depolarisation of ventricles
(B)	QRS complex	(II)	End of systole
(C)	T wave	(III)	Depolarisation of atria
(D)	End of T wave	(IV)	Repolarisation of ventricles

Choose the **correct** answer from the options given below:

a. A-IV, B-I, C-III, D-II b. A-I, B-IV, C-III, D-II
c. A-IV, B-III, C-I, D-II d. A-III, B-I, C-IV, D-II

51. Which one of the following statements is correct? [MR^4] *(2022)*

a. Increased ventricular pressure causes closing of the semilunar valves
b. The atrio-ventricular node (AVN) generates an action potential to stimulate atrial contraction
c. The tricuspid and the bicuspid valves open due to the pressure exerted by the simultaneous contraction of the atria
d. Blood moves freely from atrium to the ventricle during joint diastole.

52. The QRS complex in a standard ECG represents: *(2020)*

a. Depolarisation of auricles
b. Depolarisation of ventricles
c. Repolarisation of ventricles
d. Repolarisation of auricles

53. What would be the heart rate of a person if the cardiac output is 5 L, blood volume in the ventricles at the end of diastole is 100 mL and at the end of ventricular systole is 50 mL? [MR^2] *(2019)*

a. 50 beats per minute b. 75 beats per minute
c. 100 beats per minute d. 125 beats per minute

54. Match the Column-I with Column-II *(2019)*

	Column I		Column II
A.	P - wave	i.	Depolarisation of ventricles
B.	QRS complex	ii.	Repolarisation of ventricle
C.	T - wave	iii.	Coronary ischemia
D.	Reduction in the size of T-wave	iv.	Depolarisation of atria
		v.	Repolarisation of atria

Select the correct option.

a. A-iv B-i C-ii D-iii
b. A-iv B-i C-ii D-v
c. A-ii B-i C-v D-iii
d. A-ii B-iii C-v D-iv

55. Match the items given in Column I with those in Column II and select the correct option given below: [MR^4] *(2018)*

	Column I		Column II
A.	Tricuspid valve	i.	Between left atrium and left ventricle
B.	Bicuspid valve	ii.	Between right ventricle and pulmonary artery
C.	Semilunar valve	iii.	Between right atrium and right ventricle

a. A-iii B-i C-ii b. A-i B-iii C-ii
c. A-i B-ii C-iii d. A-ii B-i C-iii

56. Blood pressure in the mammalian aorta is maximum during: *(2015)*

a. Systole of the left ventricle
b. Diastole of the right atrium
c. Systole of the left atrium
d. Diastole of the right ventricle

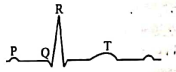
57. Which one of the following animals has two separate circulatory pathways? *(2015 Re)*

a. Lizard b. Whale
c. Shark d. Frog

58. Doctors use stethoscope to hear the sounds produced during each cardiac cycle. The second sound is heard when: *(2015 Re)*

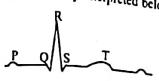
a. Ventricular walls vibrate due to pushing in of blood from atria
b. Semilunar valves close down after the blood flows into vessels from ventricles
c. AV node receives signal from SA Node
d. AV valves open up

59. The diagram given here is the standard ECG of a normal person. The P-wave represents the: *(2013)*



a. End of systole
b. Contraction of both the atria
c. Initiation of the ventricular contraction
d. Beginning of the systole

60. Given below is the ECG of a normal human. Which one of its components is correctly interpreted below? *(2011 Mains)*



a. Peak P and Peak R together – Systolic and Diastolic blood pressures
b. Peak P – Initiation of left atrial contraction only
c. Complex QRS – One complete pulse
d. Peak T – Initiation of total cardiac contraction

61. 'Bundle of His' is a part of which one of the following organs in humans? *(2011 Pre)*

a. Pancreas b. Brain
c. Heart d. Kidney

62. Arteries are best defined as the vessels which: *(2011 Pre)*

a. Carry blood from one visceral organ to another visceral organ
b. Supply oxygenated blood to the different organs
c. Carry blood away from the heart to different organs
d. Break up into capillaries which reunite to form a vein

63. If due to some injury, chordae tendineae of tricuspid valve of the heart are partially non-functional, what will be the immediate effect? [OS] *(2010 Pre)*

a. The 'pace-maker' will stop working
b. Blood will tend to flow back into left atrium
c. Flow of blood into pulmonary artery will be reduced
d. Flow of blood into aorta will be slowed down

64. Fastest distribution of some injectable material/medicine and with no risk of any kind can be achieved by injecting it into: *(2010 Mains)*

a. Artery b. Vein
c. Muscle d. Lymph vessel

65. What is correct about ECG? *(2009)*

a. P- Depolarisation of atria
b. R- Repolarisation of ventricles
c. T- Start of systole
d. T- End of diastole

66. The cardiac pacemaker in a patient fails to function normally. The doctors find that an artificial pacemaker is to be grafted in him. It is likely that it will be grafted at the site of: *(2004)*

a. Purkinje system b. S.A. node
c. Atrioventricular node d. Atrioventricular bundle

67. Bundle of His is a network of: *(2003)*

a. Muscle fibres distributed throughout the heart walls
b. Muscle fibres found only in the ventricle wall
c. Nerve fibres distributed in ventricles
d. Nerve fibres found throughout the heart

68. Impulse of heart beat originates from: *(2002)*

a. SA Node b. AV Node
c. Vagus Nerve d. Cardiac Nerve

69. Ventricular contraction in command of: *(1999)*

a. S.A. Node b. A.V. Node
c. Purkinje fibres d. Papillary muscles

70. Arterial blood pressure in human beings: *(1998)*

a. 120 and 80 mm Hg b. 150 and 100 mm Hg
c. 50 and 100 mm Hg d. None

71. Which vertebrate organ receives only oxygenated blood? *(1996)*

a. Spleen b. Liver
c. Gill d. Lung

72. The correct route through which pulse-making impulse travels in the heart is: *(1995)*

a. SA node → Purkinje fibres → bundle of His → AV node → Heart muscles
b. SA node → AV node → bundle of His → Purkinje fibres → Heart muscles
c. AV node → bundle of His → SA node → Purkinje fibres → Heart muscles
d. AV node → SA node → Purkinje fibres → bundle of His → Heart muscles

73. In veins, valves are present to check backward flow of blood flowing at: *(1995)*

a. Atmospheric pressure b. High pressure
c. Low pressure d. All of these

74. The heart sound 'dup' is produced when: *(1994)*

a. Mitral valve is closed
b. Semi-lunar valves at the base of aorta get closed
c. Tricuspid valve is opened
d. Mitral valve is opened

75. The pace setter in the heart is called: *(1994)*

a. Sino-atrial node (SAN) b. Atrio-ventriuclar node (AVN)
c. Purkinje fibres d. Papillary muscle

76. Which of the following does not have an open circulatory system? *(1994)*

a. Frog's tadpole b. Prawn
c. *Chelifer* d. Cockroach

77. Carbonic anhydrase occurs in: *(1991)*

a. Lymphocytes b. Blood plasma
c. RBC d. Leucocytes

78. Splenic artery arises from: [OS] *(1991)*

a. Anterior mesenteric artery
b. Celiac artery
c. Posterior mesenteric artery
d. Intestinal artery

79. A vein possesses a large lumen because: *(1990)*

a. Tunica media and tunica externa form a single coat
b. Tunica interna and tunica media form a single coat
c. Tunica interna, tunica media and tunica externa are thin
d. Tunica media is a thin coat

80. Arteries carry oxygenated blood except: *(1989)*
a. Pulmonary b. Cardiac
c. Hepatic d. Systemic

81. Removal of calcium from freshly collected blood would: *(1989)*
a. Cause delayed clotting
b. Prevent clotting
c. Cause immediate clotting
d. Prevent destruction of haemoglobin

82. Tricuspid valve is found in between: *(1989)*
a. Sinus venosus and right auricle
b. Right auricle and right ventricle
c. Left ventricle and left auricle
d. Ventricle and aorta

Double Circulation & Regulation of Cardiac Activity

83. A unique vascular connection between the digestive tract and liver is called *(2022 Re)*
a. Hepato-cystic system b. Hepato-pancreatic system
c. Hepatic portal system d. Renal portal system

84. Which of the following is associated with decrease in cardiac output? *(2020-Covid)*
a. Parasympathetic neural signals
b. Pneumotaxic centre
c. Adrenal medullary hormones
d. Sympathetic nerves

85. The hepatic portal vein drains blood to liver from *(2017-Delhi)*
a. Heart b. Stomach
c. Kidneys d. Intestine

86. Systemic heart refers to: *(2003)*
a. The heart that contracts under stimulation from nervous system
b. Left auricle and left ventricle in higher vertebrates
c. Entire heart in lower vertebrates
d. The two ventricles together in humans

87. In which point pulmonary artery is different from pulmonary vein? *(2000)*
a. Its lumen is broad
b. Its wall is thick
c. It have valves
d. It does not possess endothelium

88. The neurogenic heart is the characteristic feature of: *(1994)*
a. Humans b. Arthropods
c. Rabbits d. Rats

89. Blood capillaries are made of: *(1993)*
a. Endothelium connective tissue and muscle fibres
b. Endothelium and muscle fibres
c. Endothelium and connective tissue
d. Endothelium only

90. Wall of blood capillary is formed of: *(1991)*
a. Haemocytes b. Parietal cells
c. Endothelial cells d. Oxyntic cells

Disorders of Circulatory System

91. Blood pressure in the pulmonary artery is: *(2016 - I)*
a. Same as that in the aorta
b. More than that in the carotid
c. More than that in the pulmonary vein
d. Less than that in the vena cava

92. Which one of the following statements is correct regarding blood pressure? *(2011 Pre)*
a. 190/110 mmHg may harm vital organs like brain and kidney
b. 130/90 mmHg is considered high and requires treatment
c. 100/55 mmHg is considered an ideal blood pressure
d. 105/50 mmHg makes one very active

93. Given below are four statements, A - D, regarding human blood circulatory system.
A. Arteries are thick walled and have narrow lumen as compared to veins
B. Angina is acute chest pain when the blood circulation to brain is reduced
C. Persons with blood group AB can donate blood to any person with any blood group under ABO system
D. Calcium ions play a very important role in blood clotting
Which two of the above statements are correct? *[MR*] (2010 Mains)*
a. A and B b. A and D
c. B and C d. C and D

94. Glucose 6-phosphate dehydrogenase deficiency is associated with haemolysis of: *(2005)*
a. Leucocytes b. Lymphocytes
c. Platelets d. RBCs

95. Lead concentration in blood is considered alarming if it is: *[OS] (2004)*
a. 30µg/100 ml b. 4-6 µg/100 ml
c. 10µg/100 ml d. 20µg/100 ml

Answer Key

1. (d)	2. (c)	3. (b)	4. (a)	5. (d)	6. (c)	7. (d)	8. (a)	9. (d)	10. (a)
11. (a)	12. (b)	13. (b)	14. (b)	15. (c)	16. (b)	17. (a)	18. (d)	19. (c)	20. (d)
21. (a)	22. (c)	23. (a)	24. (d)	25. (b)	26. (a)	27. (c)	28. (d)	29. (c)	30. (b)
31. (a)	32. (a)	33. (d)	34. (d)	35. (b)	36. (c)	37. (c)	38. (a)	39. (a)	40. (b)
41. (b)	42. (d)	43. (b)	44. (c)	45. (a)	46. (b)	47. (b)	48. (d)	49. (b)	50. (d)
51. (d)	52. (b)	53. (c)	54. (a)	55. (a)	56. (a)	57. (b)	58. (b)	59. (b)	60. (c)
61. (c)	62. (c)	63. (c)	64. (b)	65. (a)	66. (b)	67. (b)	68. (a)	69. (a)	70. (a)
71. (a)	72. (b)	73. (c)	74. (b)	75. (b)	76. (a)	77. (c)	78. (b)	79. (d)	80. (a)
81. (b)	82. (b)	83. (c)	84. (a)	85. (d)	86. (b)	87. (b)	88. (c)	89. (d)	90. (c)
91. (c)	92. (a)	93. (b)	94. (d)	95. (a)					

Explanations

1. (d) Neutrophils are the most abundant cells (60-65%) of the total WBCs and basophils are the least (0.5-1%). Basophils have S-shaped nucleus. Neutrophils, eosinophils and basophils are different types of granulocytes.

2. (c) A-(II), B-(III), C-(IV), D-(I)
(A) Eosinophils - (II) 2 – 3%
(B) Lymphocytes - (III) 20 – 25%
(C) Neutrophils - (IV) 60 – 65 %
(D) Monocytes - (I) 6 – 8%

3. (b) (c), (a), (b), (e), (d)
Erythrocytes/RBCs : 5 - 5.5 million/ mm^3
Platelets : 1,50,000 – 3,50,000/mm^3
Leucocytes (WBCs): 6000-8000 mm^{-3}
Neutrophils : 60-65%
Monocytes : 6-8 %
Eosinophils : 2-3 %

4. (a) Clot or coagulam formed mainly of a network of threads called fibrins in which dead and damaged formed elements of blood are trapped. Fibrins are formed by the conversion of inactive fibrinogens in the plasma by the enzyme thrombin.
RBCs have an average life span of 120 days after which they are destroyed in the spleen. Therefore, spleen is known as graveyard of RBCs.

5. (d) During blood coagulation, an enzyme complex called thrombokinase helps in the conversion of prothrombin into thrombin.
Thrombin enzyme is responsible for the conversion of inactive fibrinogens into fibrins in the plasma.
Renin is secreted by JG cells in response to fall in glomerular blood flow (GFR), which converts angiotensinogen in blood to angiotensin-I and further to angiotensin-II.
Epinephrine hormone is secreted by adrenal medulla during emergency situations.

6. (c) Persons with 'AB' group lack antibodies, anti-A and anti-B, in plasma and thus, these persons can accept blood from persons with AB as well as the other groups of blood. Therefore, such persons are called 'universal recipients'.

7. (d) Eosinophils- Release histamines, destructive enzymes
Basophils- Release granules containing histamine
Neutrophils- Phagocytosis
Lymphocytes- Immune response

8. (a) During subsequent pregnancies, the Rh antibodies from the mother (Rh^{-ve}) can leak into the blood of the foetus (Rh^{-ve}) and destroy the foetal RBCs. This could be fatal to the foetus or could cause severe anaemia and jaundice to the baby. This condition is called erythroblastosis foetalis.

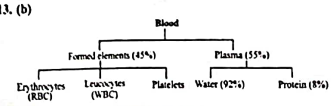
9. (d) Fibrinogen is converted into fibrin by the action of thrombin, a clotting enzyme. These fibrin makes a fibrous network to clot the blood. Globulin forms a large fraction of blood serum proteins and are involved in defence mechanism of the body. Albumin contributes to colloid osmotic pressure of plasma.

10. (a) Haemoglobin of RBC play a significant role in transport of respiratory gases.

11. (a) Plasma without the clotting factors is called serum.

12. (b) Blood normally contains 1,500,00-3,500,00 platelets mm^{-3}. Platelets can release a variety of substances most of which are involved in the coagulation or clotting of blood. A reduction in their number can lead to clotting disorders which will lead to excessive loss of blood from the body.

13. (b)



14. (b) Erythropoiesis is the process which produce red blood cells. The bone marrow is the site of production of blood cells.

15. (c) Globulins primarily are involved in defense mechanisms of the body.

16. (b) Blood group is attributed to presence of antigen on RBC. A person with AB blood group have A and B antigen on his RBCs while no antibodies in the plasma.

17. (a) K^+ is most abundant extracellular cation.

18. (d) Person having 'O' blood Group can be donated to persons with any other blood group and hence 'O' group individuals are called 'universal donors'. Persons with 'AB' group can accept blood from persons with AB as well as the other groups of blood. Therefore, such persons are called 'universal recipients'.

19. (c) The spleen is a large bean - shaped organ. It mainly contains lymphocytes and phagocytes. It acts as a filter of the blood by trapping blood-borne micro-organisms. Spleen also has a large reservoir of erythrocytes.

20. (d) 'O' is the universal donor blood group, because there is no antigen on RBC. They can donate blood to persons with any other blood group.

21. (a) Fibrinogen → fibrin → clotting of blood.

22. (c) Globulins primarily are involved in defense mechanism of the body. Albumins help in osmotic balance. Fibrinogens are needed for clotting or coagulation of blood. Haemoglobin of RBC is involved in transport of oxygen.

23. (a) Person having 'O' blood group do not have antigen on RBC.

24. (d) Neutrophils and monocytes are phagocytic cells which destroy foreign organisms entering the body.

25. (b) Basophils secrete histamine, serotonin, heparin, etc, and are involved in inflammatory reactions.

26. (a) Serum do not contains fibrinogen, and other essential clotting factors.

27. (c) Thromboplastin is necessary for the conversion of prothrombin to thrombin, an important step in blood coagulation.

28. (d) To study the blood corpuscles & plasma, it is necessary to prevent collected blood from clotting by adding chelating agents. Citrate, oxalate, heparin and EDTA are anti - coagulants.

29. (c) Vitamin - K is an essential factor for blood clotting. Its deficiency leads to improper clotting & thus continuous bleeding occurs.

30. (b) Lymph is interstitial fluid that has same mineral distribution as that in plasma. It is a colourless fluid containing specialized lymphocytes (or WBCs) that are responsible for immune responses of the body.

31. (a) People with blood group 'O' has no antigens on RBCs but do have anti - A & anti - B antibodies in serum. As they lack any antigens they are called universal donor.

32. (a) Erythroblastosis foetalis is a case of Rh incompatibility. It happens when Rh –ve mother given birth to Rh +ve children.

33. (d) Leucocytes or WBCs are colourless, nucleated cells. These are formed in bone - marrow and all leucocytes except T - lymphocytes that mature in thymus, gets matured in bone - marrow only. Its overproduction causes cancer. They can squeeze through blood capillaries into lymph vessels.

34. (d) The concentration of sodium ions in blood plasma is very which is much more than other cations.

35. (b) Agglutination occurs due to antigen - antibody reaction. It is a diagnostic method to detect the presence of certain antigens on red blood cells.

36. (c) WBCs are of two types - granulocytes (Neutrophils, eosinophils & basophils) and agranulocytes (lymphocytes & monocytes).

37. (c) WBCs (also called leucocytes) are rounded or irregular colourless cells with a nucleus. They survive for generally 3-4 days after which they die and get phagocytised in liver and lymph nodes.

38. (a) Lymph is interstitial fluid that is collected in lymphatic system and drain back to the major veins carrying blood.

39. (a) Vitamin K deficiency occurs when babies cannot stop bleeding because their blood does not have enough vitamin K to form a clot.

40. (b) Vitamin K is required for synthesis of prothrombin, a clotting factor, that regulates normal blood clotting.

41. (b) Formed elements (RBCs, WBCs & thrombocytes) are manufactured in bone marrow. Bone marrow is present in long bones (such as humerus) and is the site of hematopoiesis (formation of blood cells).

42. (d) Lymphocytes are responsible for immune responses of the body. They can be either B - lymphocytes or T-lymphocytes. B - lymphocytes are antibody producing cells.

43. (b) People with blood group AB has both antigens 'A' & 'B' on the surface of red blood cells and has no antibodies in plasma.

44. (c) A person with blood group A can take blood from person having anti - B antibody in plasma or having antigens on RBCs, i.e., blood group 'A' or 'O'. 'O' is also called a universal donor as it has no antigens on RBCs.

45. (a) Lymph is a colourless fluid containing lymphocytes, a type of WBCs.

46. (b) Rh factor plays a crucial role in child's birth born out of a marriage between Rh^- woman and a Rh^+ man.

47. (b) Haemoglobin is a complex of globular protein bounded by iron containing haem. Haem further can be decomposed into iron & a greenish pigment called biliverdin. Biliverdin is converted eventually to an orange pigment bilirubin.

48. (d) Cockroaches have white blood because cockroaches lack haemoglobin in their blood.

49. (b) In an ECG record, three recognisable waves (P-wave, QRS complex and T-wave) appear with each heartbeat.

P-wave – represents atrial depolarisation.

QRS complex – represents ventricular depolarisation.

T-wave – represents ventricular repolarisation.

Q-wave – represents initial phase of ventricular depolarisation, i.e., beginning of systole.

50. (d) A-(III), B-(I), C-(IV), D-(II)

(A) P- wave - (III) Depolarisation of atria

(B) QRS complex - (I) Depolarisation of ventricles

(C) T wave - (IV) Repolarisation of ventricles

(D) End of T wave - (II) End of systole

51. (d) During joint diastole, as the ventricular pressure declines further, the tricuspid and bicuspid valves are pushed open by the pressure in the atria exerted by the blood which was being emptied into them by the veins. The blood now once again moves freely to the ventricles.

52. (b) The QRS complex in a standard ECG represents the depolarisation of the ventricles, which initiates the ventricular contraction.

53. (c) Cardiac output = Stroke volume × Heart rate

Given, Cardiac output = 5L or 5000 ml

Blood volume in ventricles at the end of diastole = 100 ml

Blood volume in ventricles at the end of systole = 50 ml

Therefore, Stroke volume = 100 – 50 = 50 ml.

So,

$\Rightarrow$ 5000 ml = 50 ml × Heart rate

Heart rate = 100 beats per minute.

54. (a) In ECG, P-wave represents depolarisation of atria. QRS complex represents depolarisation of ventricles. T-wave represents repolarisation of ventricle, i.e., return from excited to normal state. Reduction in the size of T-wave represents inefficient supply of oxygen, i.e., coronary ischemia.

55. (a) Tricuspid valve is a muscular flap of three cusps present between right atrium and right ventricle.

Bicuspid valve is bimuscular flap prevents the backflow from left ventricle to left atrium.

Semilunar valve guards the flow of blood between right ventricle and pulmonary artery.

56. (a) Ventricular systole increases the pressure causing the closure of tricuspid and bicuspid valves due to attempted blood backflow. As the ventricular pressure increases further, the semilunar valves guarding the pulmonary artery and aorta are forced to open, allowing the blood in the ventricles to flow.

57. (b) Mammals has two different pathway for blood circulation, pulmonary and systemic.

58. (b) During each cardiac cycle, two prominent sounds are produced which can be heard by stethoscope. The first heart sound (lub) is associated with the closure of the tricuspid and bicuspid valves whereas the second heart sound (dub) is associated with a closure of the semilunar valves.

59. (b) In ECG, P wave represent depolarisation of atria which leads to the contraction of both the atria.

60. (c) The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The T-wave represents the return of the ventricles from excited to normal state (repolarisation). The end of the T-wave marks the end of systole.

Number of QRS complexes that occur in a given time period, helps to determine the heart beat rate of a an individual, i.e., one complete cycle.

61. (c) Purkinje fibers along with right and left bundles are known as bundle of His. It is a part of conducting system of heart.

62. (c) Carry oxygenated blood away from the heart.

63. (c) Pulmonary artery carries deoxygenated blood from right ventricles which have tricuspid valve to the lungs for purification. The valves allow the blood flow only in one direction.

64. (b) Intravenous route is the fastest way to deliver fluids and medications.

65. (a) P wave: Excitation (or depolarisation) of the atria.

T wave: Return of the ventricles from excited to normal state (repolarisation).

QRS: Represents the depolarisation of the ventricles.

66. (b) Sino - atrial node (SAN) is called the cardiac pacemaker. It is responsible for initiating & maintaining the rhythmic contractile activity of the heart.

67. (b) Bundle of His (or AV bundle) is the bundle of cardiac muscle fibres that passes from AV node to interventricular septum & then the ventricles. It conducts the electrical impulses from right atrium to left & right ventricles.

68. (a) SA node generate the maximum number of action potentials & are responsible for initiating the rhythmic contractile activity of heart.

69. (a) SA node generates action potential which is conducted to ventricular side by atrio - ventricular node and AV bundle from where the bundle of His transmits it through the entire ventricular musculature causes ventricular muscles to contract.

70. (a) Normal resting blood pressure in an adult is approximately 120 mmHg systolic and 80 mmHg diastolic, abbreviated as 120/80 mmhg.

71. (a) Spleen receives only oxygenated blood from the heart through splenic artery.

72. (b) SA node generates the action potential that is conducted to AV node and AV bundle from where the bundle of His transmits is to the entire ventricular musculature through purkinje fibres.

73. (c) Veins carry blood at low pressure as compared to blood carried by arteries. Valves are present in the veins to prevent backflow of blood at low pressure.

74. (b) During each cardiac cycle, 2 prominent sounds are produced - lub & dub. Dub is the second heart sound associated with the closure of semilunar valves.

75. (b) SA node is called the pace maker of the heart as it regulate the rate of heart beat & AV node conducts these signals of contractility to heart muscles, lined by endothelium and called pace setter.

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CHAPTER 16

Excretory Products and their Elimination

Excretory Organs, Human Excretory System

1. Given below are statements one is labelled as Assertion A and the other is labelled as Reason R. *(2023)*

Assertion A: Nephrons are of two types Cortical & Juxta medullary, based on their relative position in cortex and medulla.

Reason R: Juxta medullary nephrons have short loop of Henle whereas, cortical nephrons have longer loop of Henle.

In the light of the above statements, choose the correct answer from the options given below:

a. A is false but R is true.
b. Both A and R are true and R is the correct explanation of A.
c. Both A and R are true but R is NOT the correct explanation of A.
d. A is true but R is false.

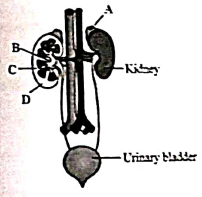
2. Nitrogenous waste is excreted in the form of pellet or paste by *(2022)*

a. *Parus* b. *Ornithorhynchus*
c. *Salamandra* d. *Hippocampus*

3. In mammals, which blood vessel would normally carry largest amount of urea? *(2016 - I)*

a. Renal Vein b. Dorsal Aorta
c. Hepatic Vein d. Hepatic Portal Vein

4. Figure shows human urinary system with structures labeled A to D. Select option which correctly identifies them and gives their characteristics and/ or functions: [MR*] *(2013)*



a. D-Cortex - Outer part of kidney and do not contain any part of nephrons.
b. A-Adrenal gland- Located at the anterior part of kidney. Secrete catecholamines which stimulate glycogen breakdown.
c. B-Pelvis-Broad funnel shaped space inner to hilum, directly connected to loops of Henle's.
d. C-Medulla - Inner zone of kidney and contains complete nephrons.

5. Which one of the following options gives the correct categorisation of six animals according to the type of nitrogenous wastes (A, B, C) they give out? [MR*] *(2012 Mains)*

	A Ammonotelic	B Ureotelic	C Uricotelic
a.	Pigeon, Humans	Aquatic Amphibia, Lizards	Cockroach, Frog
b.	Frog, Lizards	Aquatic Amphibia, Humans	Cockroach, Pigeon
c.	Aquatic Amphibia	Frog, Humans	Pigeon, Lizards, Cockroach
d.	Aquatic Amphibia	Cockroach, Humans	Frog, Pigeon, Lizards

6. Uricotelic mode of passing out nitrogenous wastes is found in: *(2011 Pre)*

a. Insects and Amphibians b. Reptiles and Birds
c. Birds and Annelids d. Amphibians and Reptiles

7. Which one of following correctly explains the function of a specific part of a human nephron? [MR*] *(2011 Pre)*

a. Afferent arteriole: Carries the blood away from the glomerular towards renal vein
b. Podocytes: Create minute spaces (slit pores) for the filtration of blood into the Bowman's capsule
c. Henle's loop: Most reabsorption of the major substances from the glomerular filtrate
d. Distal convoluted tubule: Reabsorption of K^+ ions into the surrounding blood capillaries

8. Which one of the following is not a part of a renal pyramid? *(2011 Pre)*

a. Loops of Henle's b. Peritubular capillaries
c. Convoluted tubules d. Collecting ducts

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9. The principal nitrogenous excretory compound in humans is synthesised: *(2010 Pre)*
   a. In kidneys as well as eliminated by kidneys
   b. In liver and also eliminated by the same through bile
   c. In the liver but eliminated mostly through kidneys
   d. In kidneys but eliminated mostly through liver

10. Uric acid is chief nitrogenous component of excretory products of: *(2009)*
   a. Man b. Frog
   c. Earthworm d. Cockroach

11. Match the pair of items with the category of organs: *(2008)*
   a. Nephridia of earthworm and malpighian tubules of Cockroach: Excretory organ
   b. Wings of Honey Bee and Crow: Homologous organs
   c. Nictitating membrane and blind spot in human eye: Vestigial organs
   d. Thorns of *Bougainvillea* and tendrils of *Cucurbita*: Analogous organs

12. A terrestrial animal must be able to: *(2004)*
   a. Conserve water
   b. Active pump salts out through the skin
   c. Excrete large amounts of salts in urine
   d. Excrete large amounts of water in urine

13. Uricotelism is found in: *(2004)*
   a. Fishes and fresh water protozoans
   b. Birds, reptiles and insects
   c. Frogs and toads
   d. Mammals and birds

14. The basic functional unit of human kidney is: *(1997)*
   a. Nephridia b. Henle's loop
   c. Nephron d. Pyramid

15. In ureotelic animals, urea is formed by: **[OS]** *(1997)*
   a. Krebs cycle b. EM pathway
   c. Ornithine cycle d. Cori's cycle

16. Which one of the four parts mentioned below does not constitute a part of single uriniferous tubule? *(1994)*
   a. Distal convoluted tubule b. Collecting duct
   c. Bowman's capsule d. Loop of Henle

17. Two examples in which the nitrogenous wastes are excreted from body in the form of uric acid are: *(1994)*
   a. Birds and lizard b. Frogs and cartilaginous fish
   c. Insects and bony fish d. Mammals and molluscs

18. Kidney of adult rabbit is: **[OS]** *(1992)*
   a. Pronephros b. Metanephros
   c. Mesonephros d. Opisthonephros

19. Proximal and distal convoluted tubules are parts of: *(1990)*
   a. Seminiferous tubules b. Nephron
   c. Oviduct d. Vas deferens

Urine Formation, Function of Tubules

20. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**
Assertion (A): Ascending limb of loop of Henle is impermeable to water and allows transport of electrolytes actively or passively.
Reason (R): Dilution of filtrate takes place due to efflux of electrolytes in the medullary fluid.
In the light of the above statements, choose the correct answer from the options given below: *(2023-Manipur)*
   a. **(A)** is true but **(R)** is false
   b. **(A)** is false but **(R)** is true
   c. Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**
   d. Both **(A)** and **(R)** are true and **(R)** is not the correct explanation of **(A)**

21. Which of the following statements is correct? **[MR*]** *(2017-Delhi)*
   a. The ascending limb of loop of Henle is impermeable to water
   b. The descending limb of loop of Henle is impermeable to water
   c. The ascending limb of loop of Henle is permeable to water
   d. The descending limb of loop of Henle is permeable to electrolytes

22. The part of nephron involved in active reabsorption of sodium is: *(2016 - II)*
   a. Bowman's capsule
   b. Descending limb of Henle's loop
   c. Distal convoluted tubule
   d. Proximal convoluted tubule

23. Removal of proximal convoluted tubule from the nephron will result in: *(2015)*
   a. No change in quality and quantity of urine
   b. No urine formation
   c. More diluted urine
   d. More concentrated urine

24. Which of the following does not favour the formation of large quantities of dilute urine? *(2015)*
   a. Renin b. Atrial-natriuretic factor
   c. Alcohol d. Caffeine

25. The maximum amount of electrolytes and water (70 - 80 percent) from the glomerular filtrate is reabsorbed in which part of the nephron? *(2012 Pre)*
   a. Descending limb of loop of Henle's
   b. Ascending limb of loop of Henle's
   c. Distal convoluted tubule
   d. Proximal convoluted tubule

26. Which one of the following statements in regard to the excretion by the human kidneys is correct? **[MR*]** *(2010 Pre)*
   a. Distal convoluted tubule is incapable of reabsorbing HCO_3^-
   b. Nearly 99% of glomerular filtrate is reabsorbed by renal tubules
   c. Ascending limb of loops of Henle is impermeable to electrolytes
   d. Descending limb of loops of Henle is impermeable to water

27. Removal of proximal convoluted tubule from the nephron will result in: *(2010 Mains)*
   a. No change in quality and quantity of urine
   b. No urine formation
   c. More diluted urine
   d. More concentrated urine

28. A person on long hunger strike and surviving only on water will have: *(2007)*
   a. Less amino acid in urine b. More glucose in blood
   c. Less urea in urine d. More sodium in urine

29. In Ornithine cycle, which of the following wastes are removed from the body? **[OS]** *(2005)*
   a. CO_2 and Urea b. Ammonia and urea
   c. Urea and urine d. CO_2 and ammonia

30. If Henle's loop were absent from mammalian nephron, which of the following is to be expected? *(2003)*
   a. There will be no urine formation
   b. There will be hardly any change in the quality and quantity of urine formed
   c. The urine will be more concentrated
   d. The urine will be more dilute

31. Conversion of ammonia to urea is done by: **[OS]** *(2000)*
   a. Ornithine cycle b. Arginine cycle
   c. Fumaric cycle d. Citrulline cycle

32. Which pair is correct? *(2000)*
   a. Sweat = Temperature regulation
   b. Saliva = Sense of food taste
   c. Sebum = Sexual attraction
   d. Humerus = Hind leg

33. The ornithine cycle removes two waste products from the blood in liver. These products are: **[OS]** *(1996)*
   a. CO_2 and ammonia b. Ammonia and uric acid
   c. CO_2 and urea d. Ammonia and urea

34. Brush border is characteristic of: *(1990)*
   a. Neck of nephron
   b. Collecting tube
   c. Proximal convoluted tubule
   d. All of the above

35. Reabsorption of useful substances from glomerular filtrate occurs in: *(1989)*
   a. Collecting tube
   b. Loop of Henle
   c. Proximal convoluted tubule
   d. Distal convoluted tubule

Mechanism of Concentration of Filtrate, Regulation of Kidney Functions, Micturition

36. Which of the following statements are correct? **[MR*]** *(2023)*
   A. An excessive loss of body fluid from the body switches off osmoreceptors.
   B. ADH facilitates water reabsorption to prevent diuresis.
   C. ANF causes vasodilation.
   D. ADH causes increase in blood pressure.
   E. ADH is responsible for decrease in GFR.
   Choose the correct answer from the options given below:
   a. C, D and E only b. A and B only
   c. B, C and D only d. A, B and E only

37. Arrange the events of Renin – Angiotensin mechanism in **correct** sequence. **[MR*]** *(2023-Manipur)*
   A. Activation of JG cells and release of renin.
   B. Angiotensin II activates release of aldosterone.
   C. Fall in glomerular blood pressure.
   D. Reabsorption of Na^+ and water from distal convoluted tubule.
   E. Angiotensinogen is converted to Angiotensin I and then to Angiotensin II.
   Choose the **correct** answer from the options given below:
   a. (C), (A), (E), (B), (D)
   b. (A), (D), (E), (C), (B)
   c. (A), (D), (C), (B), (E)
   d. (B), (A), (E), (D), (C)

38. Select the **correct** statements. **[MR*]** *(2022 Re)*
   A. Angiotensin II activates the cortex of adrenal gland to release aldosterone.
   B. Aldosterone leads to increase in blood pressure.
   C. ANF acts as a check on renin-angiotensin mechanism.
   D. ADH causes vasodilation.
   E. Vasopressin is released from adenohypophysis.
   Choose the most appropriate answer from the options given below:
   a. (A), (B) and (C) only
   b. (A), (B) and (E) only
   c. (C), (D) and (E) only
   d. (B), (C) and (D) only

39. Select the correct statement:
   a. Angiotensin II is a powerful vasodilator.
   b. Counter current pattern of blood flow is not observed in vasa recta.
   c. Reduction in Glomerular Filtration Rate activates JG cells to release renin.
   d. Atrial Natriuretic Factor increases the blood pressure.

40. The increase in osmolarity from outer to inner medullary interstitium is maintained due to: [MR*] *(2020-Covid)*
(i) Close proximity between Henle's loop and vasa recta
(ii) Counter current mechanism
(iii) Selective secretion of HCO_3^- and hydrogen ions in PCT
(iv) Higher blood pressure in glomerular capillaries
a. (iii) and (iv) b. (i), (ii) and (iii)
c. (i) and (ii) d. Only (ii)

41. Which of the following factors is responsible for the formation of concentrated urine? *(2019)*
a. Low levels of antidiuretic hormone
b. Maintaining hyperosmolarity towards inner medullary interstitium in the kidneys.
c. Secretion of erythropoietin by Juxtaglomerular complex
d. Hydrostatic pressure during glomerular filtration

42. Match the items given in Column I with those Column II and select the correct option given below [MR*] *(2018)*

	Column I (Function)		Column II (Part of Excretory System)
A.	Ultrafiltration	i.	Henle's loop
B.	Concentration of urine	ii.	Ureter
C.	Transport of urine	iii.	Urinary bladder
D.	Storage of urine	iv.	Malpighian corpuscle
		v.	Proximal convoluted tubule

a. A-iv B-v C-ii D-iii
b. A-iv B-i C-ii D-iii
c. A-v B-iv C-i D-ii
d. A-v B-iv C-i D-iii

43. A decrease in blood pressure/volume will not cause the release of *(2017-Delhi)*
a. Renin b. Atrial Natriuretic Factor
c. Aldosterone d. ADH

44. Which of the following does not favour the formation of large quantities of dilute urine? *(2015)*
a. Renin b. Atrial-natriuretic factor
c. Alcohol d. Caffeine

45. Human urine is usually acidic because: *(2015 Re)*
a. Excreted plasma proteins are acidic
b. Potassium and sodium exchange generates acidity
c. Hydrogen ions are actively secreted into the filtrate
d. The sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries

46. Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule? *(2014)*
a. Decrease in antidiuretic hormone levels
b. Increase in aldosterone levels
c. Increase in antidiuretic hormone levels
d. Decrease in aldosterone levels

47. A fall in glomerular filtration rate (GFR) activates *(2012 Malay)*
a. Juxta glomerular cells to release renin
b. Adrenal cortex to release aldosterone
c. Adrenal medulla to release adrenaline
d. Posterior pituitary to release vasopressin

48. Which one of the following statements is correct with respect to kidney function regulation? [MR*] *(2011 Pre)*
a. During summer when body loses lot of water by evaporation, the release of ADH is suppressed
b. When someone drinks lot of water, ADH release is suppressed
c. Exposure to cold temperature stimulates ADH release
d. An increase in glomerular blood flow stimulates formation of Angiotensin II

49. A large quantity of fluid is filtered out of blood every day by nephrons. Only 1% of it is excreted as urine. The remaining 90% *(2010 Pre)*
a. Gets collected in renal pelvis
b. Is lost as sweat
c. Is absorbed into blood
d. Is stored in urinary bladder

50. What will happen if stretch receptors of urinary bladder wall are totally removed? *(2005)*
a. There will be no micturition
b. Urine will not collect in bladder
c. Micturition will continue
d. Urine will continue to collect normally in bladder

51. Angiotensinogen is a protein secreted by: *(2006)*
a. Juxtaglomerular cells b. Macula densa cells
c. Endothelial cells d. Liver cells

52. A fall in glomerular filtration rate (GFR) activates: *(2001)*
a. Juxtaglomerular cells to release renin
b. Adrenal cortex to release aldosterone
c. Adrenal medulla to release adrenaline
d. Posterior pituitary to release vasopressin

53. Concentration of urine depends upon which organ? *(2000)*
a. Bowman's capsule
b. Length of Henle's loop
c. P.C.T.
d. Network of capillaries arising from glomerulus

54. Which hormone is concerned with the concentration of urine? *(1999)*
a. Oxytocin b. Vasopressin
c. Prolactin d. Cortisol

55. If excess water passes out from the tissue without being restored by the kidneys, the cells would: *(1994)*
a. Burst open and die
b. Take water from the plasma
c. Not be affected at all
d. Shrivel and die

56. Glucose is taken back from glomerular filtrate through: *(1993)*
a. Active transport b. Passive transport
c. Osmosis d. Diffusion

57. Under normal conditions which one is completely reabsorbed in the renal tubule? *(1991)*
a. Urea b. Uric acid
c. Salts d. Glucose

Role of Other Organs and Excretory Disorders

58. Use of an artificial kidney during hemodialysis may result in: [MR*] *(2019)*
A. Nitrogenous waste build-up in the body
B. Non-elimination of excess potassium ions
C. Reduced absorption of calcium ions from gastro-intestinal tract
D. Reduced RBC production
Which of the following option is the most appropriate?
a. (A) and (B) are correct
b. (B) and (C) are correct
c. (C) and (D) are correct
d. (A) and (D) are correct

59. Match the items given in Column I with those in Column II and select the correct option given below [MR*] *(2018)*

	Column I		Column II
A.	Glycosuria	i.	Accumulation of uric acid in joints
B.	Gout	ii.	Mass of crystallised salts within the kidney
C.	Renal calculi	iii.	Inflammation in glomeruli
D.	Glomerular nephritis	iv.	Presence of glucose in urine

a. A-iii B-ii C-iv D-i
b. A-i B-ii C-iii D-iv
c. A-ii B-iii C-i D-iv
d. A-iv B-i C-ii D-iii

60. Presence of RBC in urine is: *(1988)*
a. Alkaptonuria b. Urolithiasis
c. Hematuria d. Proteinuria

Answer Key

1. (d)	2. (a)	3. (c)	4. (b)	5. (c)	6. (b)	7. (b)	8. (c)	9. (c)	10. (d)
11. (a)	12. (a)	13. (b)	14. (c)	15. (c)	16. (b)	17. (a)	18. (b)	19. (b)	20. (c)
21. (a)	22. (d)	23. (c)	24. (a)	25. (d)	26. (b)	27. (c)	28. (c)	29. (d)	30. (d)
31. (a)	32. (a)	33. (a)	34. (c)	35. (c)	36. (c)	37. (a)	38. (a)	39. (c)	40. (c)
41. (b)	42. (b)	43. (b)	44. (a)	45. (c)	46. (b)	47. (a)	48. (b)	49. (c)	50. (a)
51. (a)	52. (a)	53. (b)	54. (b)	55. (c)	56. (a)	57. (d)	58. (c)	59. (d)	60. (c)

Explanations

1. (d) In majority of nephrons, the loop of Henle is too short and extends only very little into the medulla. Such nephrons are called cortical nephrons. In some of the nephrons, the loop of Henle is very long and runs deep into the medulla. These nephrons are called juxta medullary nephrons.

2. (a) *Pavo* is a bird, *Ornithorhynchus* is a mammal, *Salamandra* is an amphibian and *Hippocampus* is a bony fish.
Reptiles, birds, land snails and insects excrete nitrogenous wastes as uric acid in the form of pellet or paste with a minimum loss of water. Such animals are called uricotelic animals.
Many bony fishes, aquatic amphibians and aquatic insects are ammonotelic in nature.
Mammals, many terrestrial amphibians and marine fishes mainly excrete urea and are called ureotelic animals.

3. (c) In mammals, hepatic vein blood vessel would normally carry largest amount of urea.

4. (b) A- Adrenal gland; B- Renal pelvis; C-Medulla; D- Cortex.

5. (c)

6. (b) Reptiles, birds, land snails and insects excrete nitrogenous wastes as uric acid in the form of pellet or paste with a minimum loss of water and are called uricotelic animals.

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7. **(b)** Podocytes are specialised squamous cell in inner wall of Bowman's capsule.
8. **(c)** Convoluted tubules located in medullary pyramids.
9. **(c)** Principal nitrogenous excretory compound produced in the liver (detoxification) but eliminated by the kidney.
10. **(d)** Uricotelic animals - Reptiles, Birds, land snails and insects.
11. **(a)** Nephridia of earthworm and malpighian tubules of cockroach are excretory in function. Wings of honey bee and crow are analogous organ. Thorns of *Bougainvillea* and tendrils of *Cucurbita* are stem modification, are homologous organs.
12. **(a)** Nitrogenous wastes in animals are eliminated with large amount of water. Terrestrial animals need to adapt themselves such that the wastes are eliminated with minimal required water. It is accomplished by reabsorption of water in kidneys.
13. **(b)** In reptiles, birds & insects, nitrogenous wastes are excreted in the form of uric acid and thus they are called uricotelic animals.
14. **(c)** Nephron is the functional unit of kidney. These are complex tubular structures containing two parts - glomerulus and renal tubule.
15. **(c)** The principle nitrogenous excretory compound in humans is urea. Urea cycle (ornithine cycle) is the series of biochemical reactions that converts ammonia, which is highly toxic, and carbon dioxide to the much less toxic urea during the excretion of metabolic nitrogen derived from the deamination of excess amino acids.
16. **(b)** Collecting duct is a long duct that extends from cortex of kidney to the inner parts of medulla. Convoluted tubules of many nephrons open into them.

(a) Reptiles, birds, land snails and insects excretes nitrogenous wastes as uric acid in the form of pellet or paste with a minimum loss of water and are called uricotelic animals.

(b) Development of kidney proceeds through a series of successive phases: the pronephros, mesonephros and metanephros. Pronephros is most immature form of kidney and metanephros is most developed.

(b) Nephron is a functional unit of kidney, composed of glomerulus & renal tubule. Proximal convoluted tubule & distal convoluted tubule are components of renal tubule along with Henle's loop.

(c) Both (A) and (R) are true and (R) is the correct explanation of (A).

The ascending limb of the loop of Henle is impermeable to water but allows electrolyte transport, contributing to the dilution of filtrate as electrolytes are actively or passively transported into the surrounding medullary fluid.

21. **(a)** Descending limb of loop of Henle is permeable to water but impermeable to electrolytes while ascending limb is impermeable to water but permeable to electrolytes.
22. **(d)** The part of nephron involved in active reabsorption of sodium is proximal convoluted tubule.
23. **(c)** Nearly all the essential nutrients and 78-80 per cent of water and electrolytes are reabsorbed by PCT. If PCT is removed, there is no water absorption hence more dilute urine is formed.
24. **(a)** Fall in GFR activate the JG cells to release renin which facilitates the absorption of water and Na^+ through activation of adrenal cortex. Hence its action result in output of less but concentrated urine.
25. **(d)** In proximal convoluted tubule, nearly all of the essential nutrients, and 70-80% of electrolytes and water are reabsorbed by this segment.
26. **(b)** DCT is capable of reabsorbing HCO_3^-. Ascending limb of Henle's loop permeable to electrolytes. Descending Limb of Henle's loop permeable to water.
27. **(c)** Nearly all the essential nutrients and 78-80 per cent of water and electrolytes are reabsorbed by PCT. If PCT is removed, there is no water absorption hence more dilute urine is formed.
28. **(c)** A person on long hunger strike and surviving only on water will have less urea in urine. Because urea is released when person takes protein rich diet.
29. **(d)** Ornithine cycle has five steps in which ammonia (NH_3) and (CO_2) are end products.
30. **(d)** Henle's loop plays a significant role in maintenance of high osmolarity of medullary interstitial fluid. As the filtrate pass upward, it get diluted due to the passage of electrolytes to medullary fluid. Thus, its removal will make urine more diluted.
31. **(a)** Ornithine cycle is a sequence of cyclic reactions in which potentially toxic products of protein catabolism are converted to non-toxic urea. It's an enzymatic process consisting of consecutive transformation of amino acid ornithine to urea.
32. **(a)** Sweating is the release of a salt - based fluid from sweat glands. It is a bodily function that helps regulating body temperature. Our body sweat to increase heat loss by evaporation, which cools down the body.
33. **(a)** Urea is formed of two molecules of ammonia and one molecule of CO_2.
34. **(c)** Proximal convoluted tubule is lined up by simple cuboidal brush border epithelium which increases the surface area for reabsorption.
35. **(c)** Nearly all of the essential nutrients are reabsorbed by the proximal convoluted tubule.
36. **(c)** An excessive loss of fluid from the body can activate osmoreceptors which stimulate the hypothalamus to release ADH. Hence, switch on osmoreceptors.

ADH cause an increase in blood pressure. An increase in blood pressure can increase the glomerular blood flow and thereby the GFR.

37. **(a)** (C), (A), (E), (B), (D)

The Renin-Angiotensin mechanism is a crucial regulatory system for blood pressure and fluid balance. It starts with a fall in glomerular blood pressure (C), which activates the juxtaglomerular (JG) cells to release renin (A). Renin then converts angiotensinogen, a plasma protein, into angiotensin I, which is further converted into angiotensin II (E). Angiotensin II, in turn, stimulates the release of aldosterone from the adrenal cortex (B), leading to the reabsorption of Na^+ and water from the distal convoluted tubule (D) to increase blood volume and pressure.

38. **(a)** Angiotensin II triggers aldosterone release from the adrenal cortex, which raises blood pressure through vasoconstriction. Hypothalamus release ADH or vasopressin through the neurohypophysis.
39. **(c)** Angiotensin II is a powerful vasoconstrictor.

Mammals have the ability to produce a concentrated urine. The Henle's loop and vasa recta play a significant role in this. The flow of filtrate in the two limbs of Henle's loop is in opposite directions and thus forms a counter current.

A fall in glomerular blood flow or glomerular blood pressure can activate the JG cells.

ANF can cause vasodilation (dilation of blood vessels) and thereby decrease the blood pressure.

40. **(c)** Mammals have the ability to produce concentrated urine. The mechanism which facilitates production of concentrated urine is known as the counter current mechanism. The Henle's loop and vasa recta of the nephrons play a significant role in this. The flow of filtrate in the two limbs of Henle's loop and the flow of blood through the two limbs of vasa recta is in counter current pattern. The proximity between the Henle's loop and vasa recta, as well as the counter current in them helps in maintaining an increasing osmolarity towards the inner medullary interstitium. Presence of such interstitial gradient helps in an easy passage of water from the collecting tubule thereby concentrating the urine.
41. **(b)** The proximity between Henle's loop and *vasa recta* as well as counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium. This mechanism help to maintain a concentration gradient in medullary interstitium so human urine is nearly four times concentrated than initial filtrate formed.
42. **(b)** Malpighian corpuscle filters the component of nephrons in the kidney. Concentration of urine takes place through Henle's loop, now the concentrated urine is carried by ureter to urinary bladder where the urine is stored till micturition.
43. **(b)** ANF check on the renin- angiotensin mechanism. An increase in blood flow to the atria of the heart causes the release of Atrial Natriuretic Factor (ANF). ANF causes vasodilation (dilation of blood vessels) and thereby decreases the blood pressure.
44. **(a)** Fall in GFR activate the JG cells to release renin which facilitates the absorption of water and Na^+ through activation of adrenal cortex. Hence its action result in output of less but concentrated urine.
45. **(c)** PCT helps to maintain the pH and ionic balance of the body fluids by selective secretion of hydrogen ions, NH_3 and K^+ into the filtrate. This makes the urine acidic.
46. **(b)** Fall in GFR, followed by release of renin which converts Angiotensinogen to Angiotensin I then Angiotensin I converted into Angiotensin II. Angiotensin II activates the adrenal cortex to release aldosterone which causes Na^+ reabsorption from distal parts of the tubule.
47. **(a)** A fall in glomerular filtration rate (GFR) activates juxta glomerular cell to release renin.
48. **(b)** When ADH is not released, DCT becomes less permeable to water and excess of water is eliminated.

Vasopressin acts mainly at the kidney and stimulates resorption of water and electrolytes by the distal tubules and thereby reduces loss of water through urine (diuresis). Hence, it is also called as anti-diuretic hormone (ADH).

49. **(c)** Special arrangement of Henle's loop and Vasa recta is called counter-current mechanism. Complex regulatory role of JGA by kidney facilitates 99% reabsorption of the filtrate (urine) by renal tubules then to the blood.
50. **(a)** Stretch receptors on the wall of urinary bladder sends impulse to CNS and in response moter signals sent by CNS, initiates bladder contraction to release urine. It regulates micturition.
51. **(a)** Angiotensinogen is a plasma protein secreted by liver cells. Renin secreted by the juxta glomerular apparatus (JGA) acts on Angiotensinogen to convert this to Angiotensin I & then Angiotensin II.
52. **(a)** Fall in glomerular filtrate rate activates juxtaglomerular cells to release renin which converts angiotensinogen in blood to angiotensin I & II that constricts the blood vessels and increase GFR.
53. **(b)** Loop of Henle is a hairpin loop structure situated between the proximal convoluted tubule & distal convoluted tubule. It plays a key role in concentration of the urine.
54. **(b)** Vasopressin or anti-diuretic hormone (ADH) facilitates the water reabsorption from latter parts of the tubule in kidney.
55. **(c)** Individual cells have no role to play in this process.
56. **(a)** Substances like glucose, amino acids, Na^+, etc. in the filtrate are reabsorbed actively.
57. **(d)** Nutrients are completely absorbed in renal tubule. If nutrients, including glucose, is not fully reabsorbed and is excreted out in urine then this is a diseased condition, e.g., glucosuria, ketonuria, proteinuria, etc.
58. **(c)** Statements (A) and (B) are incorrect because dialysis eliminates urea and potassium from the body. During dialysis, phosphate ions along with calcium ions are eliminated. So, there will be reduced absorption of calcium ions from gastrointestinal tract. RBC production will be reduced, due to reduced erythropoietin hormone. Thus, statements (C) and (D) are correct.
59. **(d)** Glycosuria – presence of glucose in urine, e.g., Diabetes.

Gout – Uric acids are accumulated in joints

Renal calculi – Mass of crystallised salts are accumulated within kidney

Glomerular nephritis – Inflammation in Glomerulus.

60. **(c)** If blood comes in urine, it is termed as hematuria. Proteinuria, on other hand, is a condition of presence of proteins in urine.

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CHAPTER 17

Locomotion and Movement

Types of Movement and Muscle

1. Which of the following statements are correct regarding skeletal muscle? : [MR*] *(2023)*
   A. Muscle bundles are held together by collagenous connective tissue layer called fascicle.
   B. Sarcoplasmic reticulum of muscle fibre is a store house of calcium ions.
   C. Striated appearance of skeletal muscle fibre is due to distribution pattern of actin and myosin proteins.
   D. M line is considered as functional unit of contraction called sarcomere.
   Choose the most appropriate answer from the options given below
   a. C and D only b. A, B and C only
   c. B and C only d. A, C and D only
2. According to the sliding filament theory *(2022 Re)*
   a. The actin filaments slide away from A-band resulting in shortening of sarcomere.
   b. Actin and myosin filaments slide over each other to increase the length of the sarcomere.
   c. Length of A-band does not change.
   d. I-band increases in length.
3. During muscular contraction which of the following events occur? [MR*] *(2021)*
   A. 'H' zone disappears
   B. 'A' band widens
   C. 'I' band reduces in width
   D. Myosin hydrolyzes ATP, releasing the ADP and Pi
   E. Z-lines attached to actins are pulled inwards
   Choose the correct answer from the options given below.
   a. A, B, C, D only b. B, C, D, E only
   c. B, D, E, A only d. A, C, D, E only
4. Calcium is important in skeletal muscle contraction because it: *(2018)*
   a. Binds to troponin to remove the masking of active sites on actin for myosin.
   b. Activates the myosin ATPase by binding to it.
   c. Detaches the myosin head from the actin filament.
   d. Prevents the formation of bonds between the myosin cross bridges and the actin filament.
5. Name the ion responsible for unmasking of active sites for myosin for cross-bridge activity during muscle contraction. *(2016-II)*
   a. Sodium b. Potassium
   c. Calcium d. Magnesium
6. Sliding filament theory can be best explained as: *(2015)*
   a. Actin and myosin filaments do not shorten but rather slide pass each other
   b. When myofilaments slide pass each other, myosin filaments shorten while actin filaments do not shorten
   c. When myofilaments slide pass each other, actin filaments shorten while myosin filament do not shorten
   d. Actin and myosin filaments shorten and slide pass each other
7. Stimulation of a muscle fibre by a motor neuron occurs at: *(2014)*
   a. The sarcoplasmic reticulum
   b. The neuromuscular junction
   c. The transverse tubules
   d. The myofibril
8. The H-Zone in the skeletal muscle fibre is due to: *(2013)*
   a. Extension of myosin filaments in the central portion of the A-band
   b. The absence of myofibrils in the central portion of A-band
   c. The central gap between myosin filaments in the A-band
   d. The central gap between actin filaments extending through myosin filaments in the A-band
9. Contractile protein of skeletal muscle involving ATPase activity is: *(2006)*
   a. Troponin b. Tropomyosin
   c. Myosin d. α-actin
10. ATPase enzyme needed for muscle contraction is located in: *(2004)*
    a. Troponin b. Myosin
    c. Actin d. Actinin
11. Which statement is correct for muscle contraction? *(2001)*
    a. Length of H-Zone become decrease
    b. Length of A-band remains constant
    c. Length of I-band become increase
    d. Length of two Z-line become increase
12. Contractile protein is: *(1998)*
    a. Actin b. Myosin
    c. Troponin d. Tropomyosin
13. Unit of contraction: *(1998)*
    a. Sarcomere b. Muscle fibre
    c. S.R. d. Actin
14. When a muscle bends one part upon the other, it is called: [OS] *(1996)*
    a. Abductor b. Regulator
    c. Extremor d. Flexor

Skeletal System

15. Match List-I with List-II. [MR*] *(2023-Manipur)*

	List-I		List-II
(A)	Palm bones	(I)	Phalanges
(B)	Wrist bones	(II)	Metacarpals
(C)	Ankle bones	(III)	Carpals
(D)	Digit bones	(IV)	Tarsals

Choose the **correct** answer from the options given below:
a. A-II, B-III, C-I, D-IV
b. A-IV, B-I, C-II, D-III
c. A-III, B-IV, C-I, D-II
d. A-II, B-III, C-IV, D-I

16. Match List-I with List-II. *(2021)*

	List-I		List-II
A.	Scapula	i.	Cartilaginous joints
B.	Cranium	ii.	Flat bone
C.	Sternum	iii.	Fibrous joints
D.	Vertebral column	iv.	Triangular flat bone

Choose the correct answer from the options given below.
a. A-ii B-iii C-iv D-i
b. A-iv B-ii C-iii D-i
c. A-iv B-iii C-ii D-i
d. A-i B-iii C-ii D-iv

17. Match the following columns and select the correct option. [MR*] *(2020)*

	Column-I		Column-II
1.	Floating ribs	i.	Located between second and seventh ribs
2.	Acromion	ii.	Head of the humerus
3.	Scapula	iii.	Clavicle
4.	Glenoid cavity	iv.	Do not connect with the sternum

	(1)	(2)	(3)	(4)
a.	(i)	(iii)	(ii)	(iv)
b.	(iii)	(ii)	(iv)	(i)
c.	(iv)	(iii)	(i)	(ii)
d.	(ii)	(iv)	(i)	(iii)

18. Select the correct option. [MR*] *(2019)*
    a. 8th, 9th and 10th pairs of ribs articulate directly with the sternum.
    b. 11th and 12th pairs of ribs are connected to the sternum with the help of hyaline cartilage.
    c. Each rib is a flat thin bone and all the ribs are connected dorsally to the thoracic vertebrae and ventrally to the sternum.
    d. There are seven pairs of vertebrosternal, three pairs of vertebrochondral and two pairs of vertebral ribs.
19. Out of 'X' pairs of ribs in humans only 'Y' pairs are true ribs. Select the option that **correctly** represents values of X and Y and provides their explanation: [MR*] *(2017-Delhi)*

a.	X = 12, Y = 7	True ribs are attached dorsally to vertebral column and ventrally to the sternum
b.	X = 12, Y = 5	True ribs are attached dorsally to vertebral column and sternum on the two ends
c.	X = 24, Y = 7	True ribs are dorsally attached to vertebral column but are free on ventral side
d.	X = 24, Y = 12	True ribs are dorsally attached to vertebral column but are free on ventral side

20. Glenoid cavity articulates: *(2015)*
    a. Clavicle with scapula b. Humerus with scapula
    c. Clavicle with acromion d. Scapula with acromion
21. Three of the following pairs of the human skeletal parts are correctly matched with their respective inclusive skeletal category and one pair is not matched. Identify the non-matching pair. *(2011 Mains)*

	Pairs of skeletal parts	Category
a.	Humerus and Ulna	Appendicular skeleton
b.	Malleus and Stapes	Ear ossicles
c.	Sternum and Ribs	Axial skeleton
d.	Clavicle and Glenoid cavity	Pelvic girdle

22. Which is correct description? *(2010 Pre)*
    a. First vertebra is axis which articulates with occipital condyles
    b. Parietal bone and temporal bone of skull are jointed by fibrous joint
    c. 9th and 10th pairs of ribs are called floating ribs
    d. Glenoid cavity is depression to which thigh bone articulates
23. Which one is a correct match of three items and their grouping category? *(2009)*

	Item	Group
a.	Cytosine, uracil, thiamine	Pyrimidines
b.	Malleus, incus, cochlea	Ear ossicles
c.	Ilium, ischium, pubis	Coxal bones of pelvic girdle
d.	Actin, myosin, rhodopsin	Muscle proteins

24. Which one is anatomically correct? *(2007,08)*
    a. Collar bones-3 pairs b. Salivary glands-One pair
    c. Cranial nerves-10 pairs d. Floating ribs-2 pairs

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25. What is name of joint between ribs and sternum? *(2000)*
a. Cartilaginous joint b. Angular joint
c. Gliding joint d. Fibrous joints

26. Bone related with skull is: *(2000)*
a. Coracoid b. Arytenoid
c. Pterygoid d. Atlas

27. Number of bones in hind limb of man: *(1998)*
a. 14 b. 24
c. 26 d. 30

28. The number of floating ribs in the human body is: *(1995)*
a. 3 pairs b. 2 pairs
c. 6 pairs d. 5 pairs

29. Which of the following components is a part of the pectoral girdle? *(1994)*
a. Sternum b. Acetabulum
c. Glenoid cavity d. Ilium

30. The cervical vertebrae in human is: *(1993)*
a. Same as in whale
b. More than that in rabbit
c. Double than that of horse
d. Less than that in giraffe

31. Long bones function in: *(1993)*
a. Support
b. Support, erythrocyte and leukocyte synthesis
c. Support and erythrocyte synthesis
d. Erythrocyte formation

32. Number of cervical vertebrae in camel is: [OS] *(1993)*
a. More than that of rabbit b. Less than that of rabbit
c. Same as that of whale d. More than that of horse

Joints

33. Match List-I with List-II. [MR*] *(2023)*

List-I (Type of Joint)		List-II (Found between)	
(A)	Cartilaginous Joint	(I)	Between flat skull bones
(B)	Ball and Socket Joint	(II)	Between adjacent vertebrae in vertebral column
(C)	Fibrous Joint	(III)	Between carpal and metacarpal of thumb
(D)	Saddle Joint	(IV)	Between Humerus and Pectoral girdle

Choose the correct answer from the option given below:
a. A-II, B-IV, C-III, D-I b. A-III, B-I, C-II, D-IV
c. A-II, B-IV, C-I, D-III d. A-I, B-IV, C-III, D-II

34. The pivot joint between atlas and axis is a type of *(2017-Delhi)*
a. Fibrous joint b. Cartilaginous joint
c. Synovial joint d. Saddle joint

35. Which one is correctly matched? *(2010 Mains)*
a. Tibia and fibula-Both form part of knee joint
b. Cartilage and cornea-No blood supply but do require O_2 for respiratory needs
c. Shoulder joint and elbow joint-Ball and socket joint
d. Premolars and molar-20 in all and 3 rooted

36. The type of joint between the human skull bones is called *(1994)*
a. Cartilaginous joint b. Hinge joint
c. Fibrous d. Synovial joint

Disorders of Muscular and Skeletal System

37. Gout is a type of disorder which leads to: *(2022 Re)*
a. Weakening of bones due to low calcium level
b. Inflammation of joints due to accumulation of uric acid crystals
c. Weakening of bones due to decreased bone mass
d. Inflammation of joints due to cartilage degeneration

38. Chronic auto immune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle is called as: *(2021)*
a. Muscular dystrophy b. Myasthenia gravis
c. Gout d. Arthritis

39. Match the following columns and select the correct option. [MR*] *(2020-Covid)*

Column-I		Column-II	
1.	Gout	i.	Decreased levels of estrogen
2.	Osteoporosis	ii.	Low Ca^{++} ions in the blood
3.	Tetany	iii.	Accumulation of uric acid crystals
4.	Muscular dystrophy	iv.	Auto immune disorder
		v.	Genetic disorder

	(1)	(2)	(3)	(4)
a.	(iii)	(i)	(ii)	(v)
b.	(iv)	(v)	(i)	(ii)
c.	(i)	(ii)	(iii)	(iv)
d.	(ii)	(i)	(iii)	(iv)

40. Which of the following muscular disorder is inherited? *(2019)*
a. Tetany b. Muscular dystrophy
c. Myasthenia gravis d. Botulism

41. Osteoporosis, an age-related disease of skeletal system, may occur due to: *(2016 - II)*
a. Decreased level of estrogen
b. Accumulation of uric acid leading to inflammation of joints.
c. Immune disorder affecting neuromuscular junction leading to fatigue.
d. High concentration of Ca^{++} and Na^{+}.

42. Lack of relaxation between successive stimuli in sustained muscle contraction is known as: *(2016-I)*
a. Spasm b. Fatigue
c. Tetanus d. Tonus

43. Which of the following joints would allow no movement? *(2015 Re)*
a. Cartilaginous joint b. Synovial joint
c. Ball and Socket joint d. Fibrous joint

44. Select the correct matching of the type of the joint with the example in human skeletal system: *(2014)*

	Type of Joint	Example
a.	Gliding joint	Between carpals
b.	Cartilaginous joint	Between frontal and parietal
c.	Pivot joint	Between third and fourth cervical vertebrae
d.	Hinge joint	Between humerus and pectoral girdle

45. The characteristics and an example of a synovial joint in humans is: [MR*] *(2013)*

	Characteristics	Examples
a.	Lymph filled between two bones, limited movement	Gliding joint between carpals
b.	Fluid cartilage between two bones, limited movements	Knee joints
c.	Fluid filled between two joints, provides cushion	Skull bones
d.	Fluid filled synovial cavity between two bones	Joint between atlas and axis

46. Select the correct statement with respect to locomotion in humans: *(2013)*
a. The joint between adjacent vertebrae is a fibrous joint
b. A decreased level of progesterone causes osteoporosis in old people
c. Accumulation of uric acid crystals in joints causes their inflammation
d. The vertebral column has 10 thoracic vertebrae.

47. Select the correct statement regarding the specific disorder of muscular or skeletal system: *(2012 Pre)*
a. Gout-Inflammation of joints due to extra deposition of calcium
b. Muscular dystrophy-Age-related shortening of muscles
c. Osteoporosis-Decrease in bone mass and higher chances of fractures with advancing age
d. Myasthenia gravis-Auto-immune disorder which inhibits sliding of myosin filaments

48. Low Ca^{2+} in body fluid may be cause of: *(2010 Pre)*
a. Anaemia
b. Angina pectoris
c. Gout
d. Tetany

49. Which is correctly matched? *(2005)*
a. Gliding joint-Between zygapophyses of successive vertebrae
b. Hinge joint-Between vertebrae
c. Cartilaginous joint-Skull bones
d. Fibrous joint-Between phalanges

Answer Key

1. (c)	2. (c)	3. (d)	4. (a)	5. (c)	6. (a)	7. (b)	8. (d)	9. (c)	10. (b)
11. (a, b)	12. (a, b)	13. (a)	14. (d)	15. (d)	16. (c)	17. (c)	18. (d)	19. (a)	20. (b)
21. (d)	22. (b)	23. (c)	24. (d)	25. (a, c)	26. (c)	27. (d)	28. (b)	29. (c)	30. (a)
31. (b)	32. (c)	33. (c)	34. (c)	35. (b)	36. (c)	37. (b)	38. (b)	39. (a)	40. (b)
41. (a)	42. (c)	43. (d)	44. (a)	45. (d)	46. (c)	47. (c)	48. (d)	49. (a)	

Explanations

1. **(c)** Fascicle (Muscle bundles) are formed by many muscle fibres and covered by perimysium and all of it held by epimysium. The thick filaments in A-band are also held together in the middle of this band by a thin fibrous membrane called M-line.

2. **(c)** According to the sliding filament theory, the length of the A-band remains constant during muscle contraction. The length of sarcomere shortens during contraction because the thin filaments (Actin) slide past over the thick filaments (Myosin). Thus, the I band gets reduced and the A band retains its length.

3. **(d)** During muscular contraction, the globular head of myosin acts as ATPase. It hydrolyzes ATP that leads to the formation of cross bridge. This pulls the attached actin filaments towards the centre of A band. The 'Z' line attached to these actins are also pulled inwards thereby causing a shortening of the sarcomere, i.e., contraction. Thus, during shortening of the muscle, i.e., contraction, the 'I' bands get reduced, whereas the 'A' bands retain the length. H-zone disappear during maximum contraction. The myosin then releases ADP and Pi, and goes back to its relaxed state.

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4. **(a)** Calcium bind to troponin, thus causing tropomyosin to shift from the myosin-binding sites on actin filament and muscle contraction subsequently begins as myosin binds to actin.

5. **(c)** The endoplasmic reticulum, i.e., sarcoplasmic reticulum of the muscle fibres is the storehouse of calcium ions. Increase in Ca^{2+} level leads to the binding of calcium with a subunit of troponin on actin filaments and thereby remove the masking of active sites for myosin.

6. **(a)** Sliding filament theory explains that the thin myofilaments (actin) slide over the thick myofilaments (myosin) to penetrate deeper into the bands in the contracting muscle fibres. During contraction, the individual lengths of thick and thin myofilaments remains unchanged.

7. **(b)** Neuromuscular junction is the junction between a motor neuron and the sarcolemma of the muscle fibre.

8. **(d)** The central gap between actin filaments extending through myosin filaments in A-band is the H-zone. H-zone contains thick filaments but no thin filaments.

9. **(c)** The globular head of myosin is an active ATPase enzyme and has binding sites for ATP.

10. **(b)** ATP binds to myosin head where it undergoes hydrolysis to provide energy for binding of myosin head to exposed active site on actin.

11. **(a, b)** During mucle contraction, 'A' band retain the length & length of I-band and H-zone decreases.

12. **(a, b)** Contractile proteins generate force during muscle contractions. Myosin and actin, both are contractile proteins in muscles.

13. **(a)** Portion of myofibril between two successive Z lines is considered as the functional unit of contraction (sarcomere).

14. **(d)** Flexor muscle is any muscle whose contraction bends a part of a limb on another part at a joint. It decreases the angle between bones on 2 sides of a joint.

15. **(d)** A-(II), B-(III), C-(IV), D-(I)
(A) Palm bones - (II) Metacarpals
(B) Wrist bones - (III) Carpals
(C) Ankle bones- (IV) Tarsals
(D) Digit bones - (I) Phalanges

16. **(c)** Scapula is a large triangular flat bone situated in the dorsal part of the thorax between the second and the seventh ribs.
Fibrous joints do not allow any movement. This type of joint is shown by cranium.
Sternum is a flat bone on the ventral midline of thorax.
The joint between the adjacent vertebrae in the vertebral column is cartilaginous and it permits limited movements.

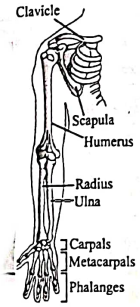
17. **(c)** 11th and 12th pairs of ribs are not connected with the sternum and are therefore, called floating ribs.
Acromion is a flat expanded process of spine of scapula. The lateral end of clavicle articulates with acromion process.
Scapula is a flat triangular bone in the dorsal part of the thorax between second and seventh ribs.
Glenoid cavity of scapula articulates with head of the humerus to form the shoulder joint.

18. **(d)**
- Vertebrosternal ribs are true ribs, dorsally they are attached to the thoracic vertebrae and ventrally connected to the sternum with the help of hyaline cartilage. First seven pairs of ribs are called true ribs and are ventrally connected to the sternum.
- 8th, 9th and 10th pairs of ribs do not articulate directly with the sternum but join the seventh ribs with the help of hyaline cartilage. These are vertebrochondral or false ribs.
- Last 2 pairs (11th & 12th) of ribs are not connected ventrally and are therefore, called floating (vertebral) ribs.

19. **(a)** 12 pairs of ribs give structural support to the sides of the thoracic cavity. Out of these 12 pairs, first 7 pairs of ribs are called true ribs. True ribs are dorsally attached to the thoracic vertebrae and ventrally connected to the sternum with the help of hyaline cartilage.

20. **(b)** In pectoral girdle, below the acromion process, there is a depression called the glenoid cavity which articulates with head of humerus.

21. **(d)** Option (d) is incorrect. As we know clavicle (collar bone) and glenoid cavity are the parts of pectoral girdle, not pelvic girdle.



22. **(b)** Atlas is the first vertebra articulating with occipital condyles. 11th and 12th pairs are floating ribs. Glenoid cavity is a depression to which humerus articulates.

23. **(c)** Thiamine is a vitamin & thymine, cytosine, uracil are pyrimidines.
Malleus, incus and stapes are ear ossicles.
Actin and myosin are muscle proteins; rhodopsin is a protein present in the rods of eye.

24. **(d)** Collar bones → 2 bones (1 pair)
Salivary glands → 3 pairs
Cranial nerves → 12 pairs
Floating ribs → 2 pairs (11th and 12th)

25. **(a, c)** Joints between the sternum and ends of the costal cartilages at the tips of second through seventh pairs of ribs are synovial planar (gliding) joints. A cartilaginous joint is present between the first rib and sternum.

26. **(c)** The pterygoid processes are projections of the sphenoid bone in the skull.

27. **(d)** Each limb is made of 30 bones. In humans, hind limb has one femur, one tibia & one fibula together, 7 tarsals, 5 metatarsals, 14 phalanges & one cup shaped bone called patella over ventral side of knee.

28. **(b)** Last 2 pairs of ribs (11th & 12th) are not connected ventrally and are, therefore, called floating ribs.

29. **(c)** Glenoid cavity is a depression found below the acromion. It articulates with the head of humerus to form the shoulder joint.

30. **(a)** Cervical vertebrae in almost all mammalian species is seven. Therefore, cervical vertebrae in human is same as in whale.

31. **(b)** Our long bones are hard, dense bones that provide strength, structure and mobility. Certain bones produces RBCs, WBCs and platelets due to the presence of red bone marrow in them.

32. **(c)** Most mammals have seven cervical vertebrae, e.g., camels, giraffes, bats, whales, rabbits, horses and humans. Therefore, number of cervical vertebrae in a camel is same as that of a whale.

33. **(c)** Cartilaginous Joints – Between adjacent vertebrae in vertebral column.
Ball and socket Joint – Between humerus and pectoral girdle.
Fibrous Joint – Between flat skull bones.
Saddle Joint – Between carpal and metacarpal of thumb.

34. **(c)** Synovial (movable) joints: They have a fluid-filled synovial cavity between articulating surfaces of 2 bones.
Types of synovial joint:
Ball & socket joint: E.g., shoulder and hip joints.
Hinge joint: E.g., knee joint, elbow joint, etc.
Pivot joint: E.g., joint between atlas & axis.
Gliding joint: E.g., joints between carpals.
Saddle joint: E.g., joint between carpal & metacarpal of thumb.

35. **(b)** Cartilage and cornea both are avascular. They do require O_2 for respiratory needs.

36. **(c)** Fibrous joint is shown by the flat skull bones which fuse end-to-end with the help of dense fibrous connective tissues, in the form of sutures. It does not allow any movement.

37. **(b)** Gout is caused by the accumulation of uric acid crystals in the joints, leading to inflammation and pain.

38. **(b)** Myasthenia gravis: Autoimmune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.
Muscular dystrophy: Progressive degeneration of skeletal muscle mostly due to genetic disorder
Arthritis: Inflammation of joints
Gout: Inflammation of joints due to accumulation of uric acid crystals.

39. **(a)** Gout: Inflammation of joints due to accumulation of uric acid crystals.
Osteoporosis: Age-related disorder characterised by decreased bone mass and increased chances of fractures. Decreased levels of estrogen is a common cause.
Tetany: Rapid spasms (wild contractions) in muscle due to low Ca^{++} in body fluid.
Muscular dystrophy: Progressive degeneration of skeletal muscle mostly due to genetic disorder.

40. **(b)** Progressive degeneration of skeletal muscle mostly due to genetic disorder is muscular dystrophy whereas tetany is rapid spasm in muscle due to low calcium in body fluid. Myasthenia gravis is an autoimmune disorder leading to paralysis of skeletal muscles. Botulism is rare and dangerous type of food poisoning caused by the toxins formed by bacterium *Clostridium botulinum*.

41. **(a)** Osteoporosis: Age-related disorder characterised by decreased bone mass and increased chances of fractures. Decreased levels of estrogen is a common cause.

42. **(c)** Lack of relaxation between successive stimuli in sustained muscle contraction is known as tetanus.

43. **(d)** Fibrous joints do not allow any movement. In cartilaginous joints, there is a little movement while synovial joints allows considerable movement.

44. **(a)** Gliding joint-Between carpals
Cartilaginous joint-Between adjacent vertebrae
Pivot joint-Between atlas and axis
Hinge joint-Knee joint

45. **(d)** Synovial joints are unique due to the presence of a space called synovial cavity (contains synovial fluid) between articulating bones. Joint between atlas and axis is a synovial pivot joint.

46. **(c)** The joint between adjacent vertebrae is a cartilaginous joint. A decreased level of estrogen causes osteoporosis in old people. The vertebral column has 12 thoracic vertebrae.

47. **(c)** Myasthenia gravis: Auto-immune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.
Muscular dystrophy: Progressive degeneration of skeletal muscle mostly due to genetic disorder.
Gout: Inflammation of joints due to accumulation of uric acid crystals.

48. **(d)** Tetany: Rapid spasms (wild contractions) in muscle due to low Ca^{2+} in body fluid.

49. **(a)** Gliding joints → Between carpals, between zygapophyses of vertebrae
Hinge joint → Knee joint
Cartilaginous joint → Adjacent vertebrae
Fibrous joint → Between bones of skull

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CHAPTER 18

Neural Control and Coordination

Neural System, Human Neural System and Neuron

1. Match List-I with List-II: [MR*] *(2022 Re)*

List-I		List-II	
(A)	Multipolar neuron	(I)	Somatic neural system
(B)	Bipolar neuron	(II)	Cerebral cortex
(C)	Myelinated nerve fibre	(III)	Retina of Eye
(D)	Unmyelinated nerve fibre	(IV)	Spinal nerves

Choose the **correct answer** from the options given below:
a. A-II, B-III, C-IV, D-I b. A-III, B-I, C-IV, D-II
c. A-II, B-IV, C-III, D-I d. A-II, B-III, C-I, D-IV

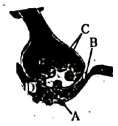
2. Select the incorrect statement regarding synapses: [MR*] *(2022)*
a. Impulse transmission across a chemical synapse is always faster than that across an electrical synapse.
b. The membranes of preseynaptic and postsynaptic neurons are in close proximity in an electrical synapse.
c. Electrical current can flow directly from one neuron into the other across the electrical synapse.
d. Chemical synapses use neurotransmitters

3. Nissl bodies are mainly composed of: *(2018)*
a. Proteins and lipids b. DNA and RNA
c. Nucleic acids and SER d. Free ribosomes and RER

4. Myelin sheath is produced by: [OS] *(2017-Delhi)*
a. Schwann Cells and Oligodendrocytes
b. Astrocytes and Schwann Cells
c. Oligodendrocytes and Osteoclasts
d. Osteoclasts and Astrocytes

5. Receptor sites for neurotransmitters are present on: *(2017-Delhi)*
a. Membranes of synaptic vesicles
b. Pre-synaptic membrane
c. Tips of axons
d. Post-synaptic membrane

6. A diagram showing axon terminal and synapse is given. Identify correctly at least two of A-D *(2013)*



a. C - Neurotransmitter; D - Ca^{++}
b. A - Receptor; C - Synaptic vesicles
c. B - Synaptic connection; D - K^+
d. A - Neurotransmitter; B - Synaptic cleft

7. A person entering an empty room suddenly finds a snake right in front on opening the door. Which one of the following is likely to happen in his neuro-hormonal control system? *(2012 Pre)*
a. Sympathetic nervous system is activated releasing epinephrine and norepinephrine from adrenal cortex
b. Sympathetic nervous system is activated releasing epinephrine and norepinephrine from adrenal medulla
c. Neurotransmitters diffuse rapidly across the cleft and transmit a nerve impulse
d. Hypothalamus activates the parasympathetic division of brain

8. When a neuron is in resting state, i.e., not conducting any impulse, the axonal membrane is: *(2011 Pre)*
a. Comparatively more permeable to K^+ ions and nearly impermeable to Na^+ ions
b. Comparatively more permeable to Na^+ ions and nearly impermeable to K^+ ions
c. Equally permeable to both Na^+ and K^+ ions
d. Impermeable to both Na^+ and K^+ ions

9. Alzheimer disease in humans is associated with the deficiency of: *(2009)*
a. Glutamic acid
b. Dopamine
c. Gamma Amino Butyric Acid (GABA)
d. Acetylcholine

10. During transmission of nerve impulse through a nerve fibre, the potential on the inner side of plasma membrane would change: [MR*] *(2007)*
a. First negative, then positive and continue to be positive
b. First positive, then negative and continue to be negative
c. First positive, then negative and again back to positive
d. First negative, then positive and again back to negative

11. Which does not act as neurotransmitter? *(2006)*
a. Acetylcholine b. Epinephrine
c. Cortisone/Tyrosine d. Nor-epinephrine

12. Four healthy people in their twenties got involved in injuries resulting in damage and death of a few cells. Which of the following cells are least likely to be replaced by new cells? *(2005)*
a. Liver cells
b. Neurons
c. Malpighian layer of skin
d. Osteocytes

13. Parkinson's disease (characterised by tremors and progressive rigidity of limbs) is due to degeneration of brain neurons involved in movement control and make use of neurotransmitter: [OS] *(2005)*
a. Acetylcholine b. Nor-epinephrine
c. Dopamine d. GABA

14. In the resting state of the neural membrane, diffusion due to concentration gradients, if allowed, would drive: *(2004)*
a. K^+ and Na^+ out of the cell
b. Na^+ into the cell
c. Na^+ out of the cell
d. K^+ into the cell

15. Which of the following statement is correct for node of Ranvier of nerve? *(2002)*
a. Neurilemma is discontinuous
b. Myelin sheath is discontinuous
c. Both neurilemma and myelin sheath are discontinuous
d. Covered by myelin sheath

16. Depolarisation of axolemma during nerve conduction takes place because of: *(2000)*
a. Equal amount of Na^+ & K^+ move out across axolemma
b. Na^+ move inside and K^+ move outside
c. More Na^+ outside
d. None

17. Neuroglial cells are associated with: *(1999)*
a. Heart b. Kidney
c. Brain d. Eyes

18. Effect of anaesthetics on body: [OS] *(1998)*
a. Inhibits Na-K pump b. Kills nerves
c. Stops brain functions d. Inactivates skin cells

19. The Nissl's Granules of nerves cell are made up of: *(1997)*
a. DNA b. RNA
c. Ribosome d. Protein

20. By which nervous system and of what type, the blood is supplied into visceral organs? *(1996)*
a. Both SNS and PNS, involuntary
b. Para-sympathetic nervous system, involuntary
c. Sympathetic nervous system, involuntary
d. Sympathetic nervous system, voluntary

21. The sympathetic nerves, in mammals, arise from: [OS] *(1995)*
a. Sacral nerves
b. 3rd, 7th, 9th and 10th cranial nerves
c. Thoracico-lumbar nerves
d. Cervical nerves

22. Afferent nerve fibres carry impulses from: *(1992)*
a. Effector organs to CNS b. Receptors to CNS
c. CNS to receptors d. CNS to muscles

23. One function of parasympathetic nervous system is: *(1990)*
a. Contraction of hair muscles
b. Stimulation of sweat glands
c. Acceleration of heart beat
d. Constriction of pupil

Central Nervous System

24. The parts of human brain that helps in regulation of sexual behaviour, expression of excitement, pleasure, rage, fear etc. are. *(2023)*
a. Corpus callosum and thalamus
b. Limbic system & hypothalamus
c. Corpora quadrigemina & hippocampus
d. Brain stem & epithalamus

25. Brainstem of human brain consists of: [MR*] *(2023-Manipur)*
a. Midbrain, Pons and Medulla Oblongata
b. Forebrain, Cerebellum and Pons
c. Thalamus, Hypothalamus and Corpora quadrigemina
d. Amygdala, Hippocampus and Corpus Callosum

26. Identify the region of human brain which has pneumotaxic centre that alters respiratory rate by reducing the duration of inspiration. *(2022 Re)*
a. Cerebrum b. Medulla
c. Pons d. Thalamus

27. Which part of the brain is responsible for thermoregulation? *(2019)*
a. Cerebrum b. Hypothalamus
c. Corpus callosum d. Medulla oblongata

28. Which of the following structures or regions is incorrectly paired with its function? [MR*] *(2018)*
a. Medulla oblongata : controls respiration and cardiovascular reflexes.
b. Limbic system : consists of fibre tracts that interconnect different regions of brain; controls movement.
c. Hypothalamus : production of releasing hormones and regulation of temperature, hunger and thirst.
d. Corpus callosum : band of fibres connecting left and right cerebral hemispheres.

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29. Which of the following regions of the brain is incorrectly paired with its function? [MR*] *(2015)*
a. Corpus callosum - Communication between the left and right cerebral cortices
b. Cerebrum - Calculation and contemplation
c. Medulla oblongata - Homeostatic control
d. Cerebellum - Language comprehension

30. Injury localised to the hypothalamus would most likely disrupt: *(2014)*
a. Regulation of body temperature
b. Short term memory
c. Co-ordination during locomotion
d. Executive function, such as decision making

31. The human hind brain comprises three parts, one of which is: *(2012 Pre)*
a. Hypothalamus b. Spinal cord
c. Corpus callosum d. Cerebellum

32. In man, abducens nerve is injured. Which one of the following functions will be affected? [OS] *(2005)*
a. Movement of eye ball b. Movement of tongue
c. Swallowing d. Movement of neck

33. Injury to vagus nerve in humans is not likely to affect: [OS] *(2004)*
a. Gastrointestinal movements
b. Pancreatic secretion
c. Cardiac movements
d. Tongue movements

34. The vagus nerve is the cranial nerve numbering [OS] *(1997)*
a. 7 b. 5
c. 10 d. 9

35. Vagus nerve is: [OS] *(1992)*
a. X b. IX
c. VII d. V

36. Third ventricle of brain is also known as: [OS] *(1990)*
a. Metacoel b. Rhinocoel
c. Paracoel d. Diacoel

37. Which of the following cranial nerves can regulate heart beat? [OS] *(1988)*
a. X b. IX
c. VII d. VII

Answer Key

1. (a)	2. (a)	3. (d)	4. (a)	5. (d)	6. (b)	7. (b)	8. (a)	9. (d)	10. (d)
11. (c)	12. (b)	13. (c)	14. (b)	15. (b)	16. (b)	17. (c)	18. (a)	19. (c)	20. (a)
21. (c)	22. (b)	23. (d)	24. (b)	25. (a)	26. (c)	27. (b)	28. (b)	29. (d)	30. (a)
31. (d)	32. (a)	33. (d)	34. (c)	35. (a)	36. (d)	37. (a)			

Explanations

1. (a)

A.	Multipolar neuron (with one axon and two or more dendrites)	-	(II)	Cerebral cortex
B.	Bipolar neuron (with one axon and one dendrite)	-	(III)	Retina of Eye
C.	Myelinated nerve fibre	-	(IV)	Spinal nerves
D.	Unmyelinated nerve fibre	-	(I)	Somatic neural system

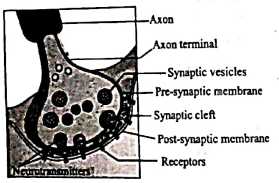
2. (a) All the statements are correct except statement (a) as impulse transmission across a chemical synapse is always slower than that across an electrical synapse.

3. (d) Nissl bodies or Nissl granules are ribosomes associated with RER in the cytoplasm of neurons.

4. (a) Oligodendrocytes are neuroglial cells which produce myelin sheath in central nervous system while Schwann cell produces myelin sheath in peripheral nervous system.

5. (d) Pre-synaptic membrane is involved in the release of neurotransmitter in the chemical synapse. The receptor sites for neurotransmitters are present on post-synaptic membrane.

6. (b)



A - Receptor, B - Synaptic cleft, C - Synaptic vesicles, D - Ca^{2+}

7. (b) The adrenal medulla secretes two hormones called adrenaline or epinephrine and noradrenaline or norepinephrine. These are commonly called as catecholamine's. Adrenaline and noradrenaline are rapidly secreted in response to stress of any kind and during emergency situations and are called emergency hormones or hormones of Fight or Flight.

8. (a) When a neuron is in resting state, i.e., not conducting any impulse, the axonal membrane is comparatively more permeable to K^+ ions and nearly impermeable to Na^+ ions.

9. (d) Alzheimer disease in humans is associated with the deficiency of acetylcholine neurotransmitter..

10. (d) During transmission of nerve impulse through a nerve fibre, the potential on the inner side of the plasma membrane is first negative, then positive and again negative by repolarisation.

11. (c) Cortisone is a corticosteroid, formed in Adrenal gland from active hormone cortisol. It maintains fat deposition in body. It promotes synthesis and storage of glucose.

12. (b) The neurons are specialised cells that conduct and relays impulses. Neurons do not have the capability of division (Cells are restricted in G_0 phase).

13. (c) Deficiency of dopamine in the human produces symptoms of Parkinson's disease.

14. (b) In resting state, the cytoplasm inside the axon has a high concentration of K^+ and a low concentration of Na^+. If diffusion occurs then Na^+ move into the cell through concentration gradient.

15. (b) Gaps between two adjacent myelin sheaths are called nodes of Ranvier.

16. (b) In the process of depolarisation, the negative internal charge of the cell temporarily becomes less negative. It is done by Na^+/K^+ pump as 3 Na^+ are pumped into the cell for every 2 K^+ out of the cell.

17. (c) The cells that form myelin; protect, support and maintain equilibrium in our nervous system are called neuroglial cells. They include astrocytes, oligodendrocytes & microglial cells.

18. (a) Anaesthetic drugs inhibit depolarisation of nerve membrane by interfering with both Na^+ & K^+ currents. The action potential is not propagated because the threshold level is never attained.

19. (c) The cell body of neuron contains cytoplasm with typical cell organelles and certain granular bodies. These granular bodies are ribosomes & are called Nissl's granules as discovered by Nissl.

20. (a) The blood is supplied into visceral organs by both SNS (sympathetic nervous system) and PNS (parasympathetic nervous system) involuntarily.

21. (c) Sympathetic nerves arise from thoracico–lumbar nerves.

22. (b) Afferent nerve fibres transmit impulses from receptors to central nervous system.

23. (d) Constriction of pupil is controlled by circular smooth muscles called sphincter muscles. The sphincter muscle has parasympathetic innervation.

24. (b) Inner parts of cerebral hemispheres and a group of associated deep structures like amygdala, hippocampus etc., form a complex structure called limbic system. Limbic system along with the hypothalamus, is involved in the regulation of sexual behaviour, expression of emotional reactions (e.g., excitement, pleasure, rage and fear), and motivation.

25. (a) Midbrain, pons, and Medulla Oblongata.
The brainstem consists of the midbrain, pons, and medulla oblongata.

26. (c) The pneumotaxic centre, located in the pons, regulates the pattern of breathing by reducing the duration of inspiration, thus altering the respiratory rate.

27. (b) Hypothalamus in the thermoregulatory centre of our brain. It contains a number of centres which control body temperature, urge for eating and drinking.

28. (b) Primary structures within limbic system includes amygdala, hippocampus, thalamus, hypothalamus, basal ganglia and cingulate gyrus.

29. (d) Language comprehension is the function of fore brain of cerebrum, in Wernicke's area whose location is temporal lobe.

30. (a) Hypothalamus contains number of centres which control body temperature, urge for eating and drinking.

31. (d) The hindbrain comprises pons, cerebellum and medulla (also called the Medulla oblongata).

32. (a) Abducens is a cranial nerve. It innervates the lateral rectus muscle of eye ball; controls the movements of the eye ball. If it is injured the movement of eyeball affected.

33. (d) Tongue movement is a voluntary movement. The hypoglossal (XII) nerve innervates all the extrinsic & intrinsic muscles of the tongue, except for palatoglossus which is innervated by X cranial nerve, vagus nerve.

34. (c) Vagus nerve is the tenth cranial nerve.

35. (a) The main nerves of our parasympathetic nervous systems vagus is nerve (X nerve).

36. (d) Ventricular system is a set of four interconnected cavities called ventricles in the brain, where the cerebrospinal fluid is produced. It is referred to as cavity of the diencephalon.

37. (a) X nerve, i.e., the vagus nerve (mixed) that arises from the side of medulla controls the visceral sensations and movements of larynx, lungs, heart, stomach and intestines.

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CHAPTER 19

Chemical Coordination and Integration

Endocrine Glands and Hormones

1. Which one of the following pairs includes only endocrine glands? *(2005)*
   a. Thymus and testes
   b. Adrenal and ovary
   c. Parathyroid and adrenals
   d. Pancreas and parathyroid
2. Find out the correct statement: *(2006)*
   a. Endocrine glands regulate neural activity but not vice versa
   b. Neurons regulate endocrine activity but not vice versa
   c. Endocrine glands regulate neural activity and nervous system regulates endocrine glands
   d. Neither hormones control neural activity nor the neurons control endocrine activity
3. Chemically hormones are: *(2004)*
   a. Proteins, steroids & biogenic amines
   b. Proteins only
   c. Steroids only
   d. Biogenic amines only
4. Minute quantity of hormones & steroid are detected by: [OS] *(1999)*
   a. Electrophoresis b. Radio-immunoassay
   c. Electro-encephalogram d. Fractional analysis
5. Symptoms of Lathyrism: [OS] *(1998)*
   a. Bone deformation
   b. Muscular dystrophy and paralysis
   c. Asphyxia
   d. Cardiac arrest
6. According to the accepted concept of hormone action, if receptor molecules are removed from target organs, then the target organ will: *(1995)*
   a. Continue to respond to the hormone without any difference
   b. Not respond to the hormone
   c. Continue to respond to the hormone but will require higher concentration
   d. Continue to respond to the hormone but in the opposite way

Hypothalamus, Pituitary Gland, Pineal Gland

7. Hormones stored and released from neurohypophysis are: *(2020-Covid)*
   a. Oxytocin and Vasopressin
   b. Follicle stimulating hormone and Luteinizing hormone
   c. Prolactin and Vasopressin
   d. Thyroid stimulating hormone and oxytocin
8. Hypersecretion of growth hormone in adults does not cause further increase in height, because [OS] *(2017-Delhi)*
   a. Growth hormone becomes inactive in adults
   b. Epiphyseal plates close after adolescence
   c. Bones loose their sensitivity to growth hormone in adults
   d. Muscle fibres do not grow in size after birth
9. GnRH, a hypothalamic hormone, needed in reproduction, acts on *(2017-Delhi)*
   a. Anterior pituitary gland and stimulates secretion of LH and oxytocin
   b. Anterior pituitary gland and stimulates secretion of LH and FSH
   c. Posterior pituitary gland and stimulates secretion of oxytocin and FSH
   d. Posterior pituitary gland and stimulates secretion of LH and relaxin
10. The posterior pituitary gland is not a 'true' endocrine gland because: *(2016 - D)*
    a. It is under the regulation of hypothalamus
    b. It secretes enzymes
    c. It is provided with a duct
    d. It only stores and releases hormones
11. Which one of the following hormones though synthesised elsewhere is stored and released by the master gland? *(2015 Re)*
    a. Luteinising hormone
    b. Prolactin
    c. Melanocyte stimulating hormone
    d. Antidiuretic hormone
12. The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone *(2011 Mains)*
    a. Adrenaline b. Melatonin
    c. Calcitonin d. Prolactin
13. Which is an accumulation and release centre of neurohormones? *(2004)*
    a. Posterior pituitary
    b. Anterior pituitary
    c. Intermediate lobe of pituitary
    d. Hypothalamus
14. Acromegaly is caused by: [OS] *(2002)*
    a. Excess of STH b. Excess of Thyroxin
    c. Deficiency of Thyroxin d. Excess of Adrenalin
15. Melanin protect from: *(2003)*
    a. U.V. rays b. Visible rays
    c. Infrared rays d. X-rays
16. Melatonin is secreted by: *(2000)*
    a. Pineal body b. Skin
    c. Pituitary Gland d. Thyroid
17. MSH is secreted by: *(2000)*
    a. Anterior lobe of pituitary
    b. Middle lobe of pituitary
    c. Posterior lobe of pituitary
    d. Endostyle
18. Oxytocin mainly helps in: *(1999)*
    a. Milk production b. Child birth
    c. Diuresis d. Gametogenesis
19. ADH or vasopressin is: *(1991)*
    a. Enzyme that hydrolyses peptides
    b. Hormone secreted by pituitary that promotes reabsorption of water from glomerular filtrate
    c. Hormone that promotes glycogenolysis
    d. Energy rich compound connected with muscle contraction
20. MSH of pars intermedia of middle pituitary is responsible for: *(1988)*
    a. Darkening of skin in lower vertebrates
    b. Light colouration of skin in lower vertebrates
    c. Both (a) and (b)
    d. Darkening of skin in human beings.

Thyroid, Parathyroid, Thymus

21. Which of the following are NOT under the control of thyroid hormone? [MR*] *(2023)*
    A. Maintenance of water and electrolyte balance
    B. Regulation of basal metabolic rate
    C. Normal rhythm of sleep-wake cycle
    D. Development of immune system
    E. Support the process of R.B.Cs formation
    Choose the correct answer from the options given below:
    a. D and E only b. A and D only
    c. B and C only d. C and D only

22. Which of the following statements are **correct** with respect to the hormone and its function? [MR*] *(2023-Manipur)*
    A. Thyrocalcitonin (TCT) regulates the blood calcium level.
    B. In males, FSH and androgens regulate spermatogenesis.
    C. Hyperthyroidism can lead to goitre.
    D. Glucocorticoids are secreted in Adrenal Medulla.
    E. Parathyroid hormone is regulated by circulating levels of sodium ions.
    Choose the **most appropriate** answer from the options given below:
    a. (C) and (E) only b. (A) and (B) only
    c. (B) and (C) only d. (A) and (D) only
23. Given below are two statements: *(2023-Manipur)*
    Statement I: Parathyroid hormone acts on bones and stimulates the process of bone resorption.
    Statement II: Parathyroid hormone along with Thyrocalcitonin plays a significant role in carbohydrate metabolism.
    In the light of the above statements, choose the **correct** answer from the options given below:
    a. **Statement I** is correct but **Statement II** is incorrect
    b. **Statement I** is incorrect but **Statement II** is correct
    c. Both **Statement I** and **Statement II** are correct.
    d. Both **Statement I** and **Statement II** are incorrect.
24. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). *(2022 Re)*
    Assertion (A): During pregnancy the level of thyroxine is increased in the maternal blood.
    Reason (R): Pregnancy is characterised by metabolic changes in the mother.
    In the light of the above statements, choose the most appropriate answer from the options given below:
    a. (A) is not correct but (R) is correct
    b. Both (A) and (R) are correct and (R) is the correct explanation of (A)
    c. Both (A) and (R) are correct but (R) is not the correct explanation of (A)
    d. (A) is correct but (R) is not correct
25. Which of the following are not the effects of Parathyroid hormone? *(2022)*
    A. Stimulates the process of bone resorption
    B. Decrease Ca^{2+} level in blood
    C. Reabsorption of Ca^{2+} by renal tubules
    D. Decrease the absorption of Ca^{2+} from digested food
    E. Increases metabolism of carbohydrates
    Choose the most appropriate answer from the options given below:
    a. B and C only b. A and C only
    c. B, D and E only d. A and E only
26. Which of the following hormones can play a significant role in osteoporosis? *(2018)*
    a. Aldosterone and Prolactin
    b. Progesterone and Aldosterone
    c. Estrogen and Parathyroid hormone
    d. Parathyroid hormone and Prolactin

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27. Thymosin is responsible for: *(2017-Delhi)*
a. Decreased production of T-lymphocytes
b. Inhibiting the production of antibodies
c. Decreasing the blood calcium level in old individuals
d. Increased production of T-lymphocytes

28. Identify the hormone with its correct matching of source and function: *(2014)*
a. Atrial natriuretic factor: Ventricular wall, increases the blood pressure
b. Oxytocin: Posterior pituitary, growth and maintenance of mammary glands
c. Melatonin: Pineal gland, regulates the normal rhythm of sleep wake cycle
d. Progesterone: Corpus luteum, stimulation of growth and activities of female secondary sex organs

29. A pregnant female delivers a baby who suffers from stunted growth, mental retardation, low intelligence quotient and abnormal skin. This is the result of: *(2013)*
a. Over-secretion of pars distalis
b. Deficiency of iodine in diet
c. Low secretion of growth hormone
d. Cancer of the thyroid gland

30. Toxic agents present in food which interfere with thyroxine synthesis lead to the development of: *(2010 Pre)*
a. Cretinism b. Simple goitre
c. Thyrotoxicosis d. Toxic goitre

31. A health disorder that results from deficiency of thyroxine in adults and characterised by (i) low metabolic rate (ii) increase in body weight and (iii) tendency to retain water in tissues is: [OS] *(2009)*
a. Simple goitre b. Myxoedema
c. Hypothyroidism d. Cretinism

32. Which hormone contains iodine? *(2009)*
a. Testosterone b. Thyroxine
c. Adrenaline d. Insulin

33. Blood calcium level is lowered by deficiency of: *(2008)*
a. Parathormone
b. Thyroxine
c. Calcitonin
d. Both Calcitonin and Parathormone

34. Parathyroid hormone deficiency leads to: *(1999)*
a. Decrease of Ca^{+2} level in blood
b. Increase of Ca^{+2} level in blood
c. Osteoporosis
d. Hypercalcemia

35. Which gland decreases in size with increasing age? *(1999)*
a. Thyroid b. Adrenal
c. Thymus d. Pituitary

36. Function of thyrocalcitonin: *(1998)*
a. To reduce the calcium level in blood
b. To increase the calcium level in blood
c. Oppose the action of thyroxine
d. Maturation of gonads

37. Addition of a trace of thyroxine or iodine in water containing tadpoles will: *(1996)*
a. Keep them in larval stage
b. Hasten their metamorphosis
c. Slow down their metamorphosis
d. Kill the tadpoles

Adrenal gland, Pancreas

38. Presence of which of the following conditions in urine is indicative of Diabetes Mellitus? *(2020)*
a. Uremia and Renal Calculi
b. Ketonuria and Glycosuria
c. Renal calculi and Hyperglycaemia
d. Uremia and Ketonuria

39. Match the following columns and select the correct option. [MR*] *(2020)*

	Column - I		Column - II
1.	Pituitary gland	(i)	Grave's disease
2.	Thyroid gland	(ii)	Diabetes mellitus
3.	Adrenal gland	(iii)	Diabetes insipidus
4.	Pancreas	(iv)	Addison's disease

	(1)	(2)	(3)	(4)
a.	(iii)	(ii)	(i)	(iv)
b.	(iii)	(i)	(iv)	(ii)
c.	(ii)	(i)	(iv)	(iii)
d.	(iv)	(iii)	(i)	(ii)

40. Which of the following would help in prevention of diuresis? *(2020)*
a. Reabsorption of Na^+ and water from renal tubules due to aldosterone
b. Atrial natriuretic factor causes vasoconstriction
c. Decrease in secretion of renin by JG cells
d. More water reabsorption due to undersecrtion of ADH

41. Select the correct statement [MR*] *(2020)*
a. Glucagon is associated with hypoglycemia.
b. Insulin acts on pancreatic cells and adipocytes.
c. Insulin is associated with hyperglycemia.
d. Glucocorticoids stimulate gluconeogenesis.

42. Match the following hormones with the respective disease: *(2019)*

A. Insulin	i. Addison's disease
B. Thyroxin	ii. Diabetes insipidus
C. Corticoids	iii. Acromegaly
D. Growth Hormone	iv. Goitre
	v. Diabetes mellitus

Select the correct option.

	(A)	(B)	(C)	(D)
a.	(v)	(i)	(ii)	(iii)
b.	(ii)	(iv)	(iii)	(i)
c.	(v)	(iv)	(i)	(iii)
d.	(ii)	(iv)	(i)	(iii)

43. Graves' disease is caused due to: [OS] *(2016 - II)*
a. Hypersecretion of adrenal gland
b. Hypersecretion of adrenal gland
c. Hyposecretion of thyroid gland
d. Hypersecretion of thyroid gland

44. A chemical signal that has both endocrine and neural roles is: *(2015)*
a. Epinephrine b. Cortisol
c. Melatonin d. Calcitonin

45. Which one of the following hormones is not involved in sugar metabolism? *(2015 Re)*
a. Aldosterone b. Insulin
c. Glucagon d. Cortisone

46. Fight-or-flight reactions cause activation of: *(2014)*
a. The pancreas leading to a reduction in the blood sugar levels
b. The parathyroid glands, leading to increased metabolic rate
c. The kidney, leading to suppression of renin angiotensin-aldosterone pathway
d. The adrenal medulla, leading to increased secretion of epinephrine and norepinephrine

47. Injury to adrenal cortex is not likely to affect secretion of: *(2010 Pre)*
a. Androstenedione and dehydroepiandrosterone
b. Adrenaline
c. Cortisol
d. Aldosterone

48. Feeling tremors of an earthquake, a scared resident begins to climb down the stairs rapidly from seventh floor due to hormone: *(2007)*
a. Glucagon b. Adrenaline
c. Gastrin d. Thyroxine

49. Which hormone causes dilation of blood vessels, increased oxygen consumption and glucogenesis? *(2006)*
a. Glucagon b. ACTH
c. Insulin d. Adrenaline

50. Steroid hormone regulating glucose metabolism is: *(2006)*
a. Cortisone b. Cortisol
c. Corticosterone d. 1,1- deoxycorticosterone

51. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency? *(2003)*
a. Relaxin – Gigantism
b. Prolactin – Cretinism
c. Parathyroid hormone – Tetany
d. Insulin – Diabetes insipidus

52. Reason, why hair loss is more in old age? *(2000)*
a. Reduction of blood supply
b. Decrease in protein synthesis
c. Low energy production
d. Reduced storage of glycogen

53. Insulin differs from growth hormone in: *(1999)*
a. Increases activity of m-RNA and ribosomes
b. Increase the permeability of cell membrane
c. Affects metabolism of fats by inducing lipogenesis
d. Increasing protein synthesis.

54. Hormones thyroxine, adrenaline and the pigment melanin are formed from: *(1997)*
a. Tyrosine b. Proline
c. Tryptophan d. Glycine

55. Insulin is a: *(1990)*
a. Vitamin b. Lipid
c. Hormone d. Enzyme

56. Which hormone possesses anti-insulin effect? *(1988)*
a. Cortisol b. Calcitonin
c. Oxytocin d. Aldosterone

Testis, Ovary, Hormones of Heart, Kidney and GI Tract

57. Match List-I with List-II. [MR*] *(2023)*

List-I		List-II	
(A)	CCK	(I)	Kidney
(B)	GIP	(II)	Heart
(C)	ANF	(III)	Gastric gland
(D)	ADH	(IV)	Pancreas

Choose the correct answer from the options given below:
a. A-IV, B-II, C-III, D-I b. A-IV, B-III, C-II, D-I
c. A-III, B-II, C-IV, D-I d. A-II, B-IV, C-I, D-III

58. Erythropoietin hormone which stimulates R.B.C. formation is produced by: *(2021)*
a. The cells of rostral adenohypophysis
b. The cells of bone marrow
c. Juxtaglomerular cells of the kidney
d. Alpha cells of pancreas.

59. Match the following columns and select the correct option: [MR*] *(2020-Covid)*

	Column-I		Column-II
1.	Ovary	(i)	Human chorionic Gonadotropin
2.	Placenta	(ii)	Estrogen & Progesterone
3.	Corpus luteum	(iii)	Androgens
4.	Leydig cells	(iv)	Progesterone only

Select the correct option from following:

	(1)	(2)	(3)	(4)
a.	(i)	(ii)	(iii)	(iv)
b.	(i)	(iii)	(ii)	(iv)
c.	(ii)	(i)	(iv)	(iii)
d.	(iv)	(iii)	(ii)	(i)

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Answer Key

1. (c)	2. (c)	3. (a)	4. (b)	5. (b)	6. (b)	7. (a)	8. (b)	9. (b)	10. (b)	11. (d)
12. (a)	13. (b)	14. (b)	15. (a)	16. (a)	17. (b)	18. (a)	19. (b)	20. (b)	21. (a)	22. (a)
23. (a)	24. (a)	25. (b)	26. (a)	27. (b)	28. (c)	29. (c)	30. (d)	31. (c)	32. (b)	33. (b)
34. (b)	35. (b)	36. (a)	37. (b)	38. (c)	39. (c)	40. (b)	41. (b)	42. (b)	43. (b)	44. (a)
45. (a)	46. (c)	47. (a)	48. (a)	49. (c)	50. (a)	51. (b)	52. (b)	53. (b)	54. (d)	55. (b)
56. (a)	57. (a)	58. (a)	59. (a)	60. (c)	61. (a)	62. (b)	63. (c)	64. (c)	65. (c)	66. (d)
67. (a)	68. (a)	69. (a)	70. (a)	71. (a)	72. (a)	73. (c)	74. (a)	75. (b)	76. (c)	77. (b)
78. (a)	79. (a)	80. (a)	81. (c)	82. (a)	83. (c)	84. (a)	85. (d)	86. (c)	87. (c)	88. (b) & (c)
89. (c)	90. (a)	91. (b)	92. (a)	93. (c)	94. (a)	95. (d)	96. (a)	97. (c)	98. (c)	99. (c)
100. (d)	101. (a)	102. (b)								

Explanations

1. (c) Pancreatic are actually an exocrine gland. They pour their secretion directly into the blood, hence they are considered as endocrine gland.

2. (c) The neural system and the endocrine system jointly coordinate and regulate the physiological functions in the body.

3. (a) Hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amounts. They are of many type based on their chemical nature.
- Peptide hormones e.g. Insulin
- Steroid hormones e.g., Oestrogens
- Protein hormones e.g. Growth hormone
- Biogenic amine e.g. Catecholamines

4. (b) Radio-immunoassay is a technique for measuring the levels of substances in samples (eg. blood) with a radioisotope & measuring the subsequent radioactivity of the substance. Invented by this method, even minute quantities of hormones or enzymes can be measured in the body.

5. (b) Cataplexy is marked by muscular weakness and paralysis. Paralysis may affect the legs, the arm or neck. It is a neurological disorder of humans.

6. (b) Gonads are the primary sex glands that produce gametes (mature sex cells) and secrete the sex hormones. Testes are the male gonads that produce sperm cells and other hormones (sex hormones) associated with spermatogenesis and male sexual characteristics. Ovaries are the female gonads that produce the ovum or egg cell. The fallopian tubes (oviducts) receive the ovum or egg cell released from the ovary. If conception occurs, the fertilized ovum moves to and implants in the uterus (womb) where it develops into a foetus.

7. (a) Neurohypophysis (post pituitary) also known as posterior pituitary, stores and releases two hormones called oxytocin and vasopressin, which are actually synthesized in the hypothalamus and are transported axonally to neurohypophysis.

8. (b) Pineal gland is responsible for the growth of sex organs. Soon after adolescence or hypersecretion of pineal hormone it arrests does not cause further increase in height.

9. (b) Hypothalamus secretes GnRH which stimulates anterior pituitary gland for the secretion of gonadotropins (FSH and LH).

10. (d) The pituitary gland is located in a bony cavity called sella turcica and is attached to hypothalamus by a stalk. It is also called master gland.

The posterior pituitary gland is not a "true" endocrine gland because it only stores and releases hormones.

11. (d) Post synaptic also known as postsynaptic does not actually produce hormones but stores and releases hormones made by the hypothalamus. Therefore posterior lobe is also called neurohypophysis. Posterior lobe secretes two hormones oxytocin and vasopressin (ADH).

12. (a) The pituitary (master) gland is the only part of the whole endocrine system that is regulated by the hormone secretions of other glands. The hypothalamus is connected to pituitary gland via a stalk called infundibulum. The hypothalamus is connected to the pituitary gland by a capillary network called hypothalamic-hypophysial portal system. Hypothalamus controls the secretion of pituitary gland hormones.

13. (b) Pineal gland produces melatonin which helps in pigmentation, the menstrual cycle and other defense capability.

14. (b) Neurohypophysis (post pituitary) also known as posterior pituitary, stores and releases the hormones.

15. (a) The secretion of a hormonal disorder that develops when pituitary gland produces too much growth hormone during childhood. Somatotropin (GH) is another name for growth hormone.

16. (a) Melanin is a protective pigment in skin that blocks the UV radiation from damaging DNA and another strong sun screen.

17. (b) Renal gland (located on dorsal side of kidney) secretes a hormone called melatonin. Melatonin plays a very important role in maintaining normal rhythm of sleep-wake cycle, body temperature, etc.

18. (a) MSH (Melanocyte Stimulating Hormone) is secreted by pars intermedia. The pars intermedia is distinct, merged with anterior pituitary, i.e., pars distalis.

19. (b) Two main functions of thymus are maturation of immune system cells and production of child's immune system.

20. (b) Vasopressin acts mainly on kidney and maintains retention of water & electrolytes by renal tubules and thereby reduces water loss through urine. It is secreted by posterior lobe of pituitary (neurohypophysis) or is actually synthesized by hypothalamus.

21. (a) MSH (Melanocyte stimulating hormone) is secreted by pars intermedia. It acts on the melanocytes and regulates pigmentation of the skin.

22. (a) Thyroid hormones play an important role in the regulation of the basal metabolic rate. These hormones also support the process of red blood cell formation. Thyroid hormones control the metabolism of carbohydrates, proteins and fat. Maintenance of water and electrolyte balance is also influenced by thyroid hormones. Thyroid gland also secretes a protein hormone called thyrocalcitonin (TCT) which regulates the blood calcium level. Melanin plays very important role in regulation of pigment of our body. It absorbs deep wider cycle, body temperature, etc. Thymus gland is development of the immune system.

23. (a) (A) and (B) only

Hypocalcaemia (TCT) regulates blood calcium level by lowering them, and PTH along with calcitriol regulates blood calcium level. Deficiency of iodine is one the cause of hypothyroidism among goitre, thyroid swells because stimulation of unresponsive and uncontrollable hormone. The secretion of Parathyroid hormone is regulated by the circulating levels of calcium ions.

24. (a) Statement I is correct but Statement II is incorrect.

Parathyroid hormone (PTH) plays a crucial role in bone metabolism by stimulating bone resorption, which increases blood calcium levels. It acts directly on bones to release calcium into the bloodstream. On the other hand, PTH does not play a significant role in calcium-ionic homeostasis.

25. (b) Increased levels of hormone during pregnancy increase the metabolic energy and increased metabolic demands of the mother.

26. (c) Statement I, II & III are not assertive the functions of parathyroid hormone is / increase calcium level in blood, increase the absorption of Ca^{2+} from intestine and calcitriol is the key hormone of calcium-ionic homeostasis.

27. (c) Compared with estrogen hormone, PTH predominantly increases the rate of bone resorption (breakdown) of osteoclast patients. Estrogen promotes the activity of bone producing osteoblasts and PTH plays a crucial role in regulating calcium-phosphate homeostasis.

28. (d) Thymus is located on the upper part of the heart and lungs. It secretes hormones (peptide hormones). Thymus is responsible for the maturation of T-lymphocytes. As maturation of lymphocytes increases, the thymus becomes smaller in size. Thymus is the primary site of T-lymphocyte development. Thymosin is the hormone of thymus.

Primary lymphoid organs are responsible for generation of immature lymphocytes.

29. (c) ADP – Bone cells increase bone resorption

Thyroxine – Promotes recovery, protein synthesis, development

Melatonin – Helps gonads regulate sexual cycles of sexual maturation cycle

Progesterone – Causes uterus to prepare implantation, prevent premature contraction of gonads

30. (b) Hypercalcitonin action suppresses calcium mobilization from bone and promotes the deposition of calcium in bone.

31. (b) Somatostatin is called growth hormone inhibiting hormone or growth hormone release inhibiting hormone (GHRIH) is a peptide hormone that regulates the endocrine system and affects neurotransmission and cell proliferation via interaction with G-protein coupled somatostatin receptors and the inhibition of the release of numerous secondary hormones.

32. (b) Testosterone is a steroid hormone from the androgen group. In male mammals, testosterone is primarily secreted in the testicles of the testes and the adrenal glands. It is the principal male sex hormone and an anabolic steroid. In male humans, testosterone plays a key role in the development of male reproductive tissues such as testes and prostate as well as promoting secondary sexual characteristics such as increased muscle and bone mass, and the growth of body hair.

33. (b) Testosterone is a hypocalcaemic hormone, as it increases the blood Ca^{2+} level.

34. (b) Parathyroid hormone (PTH) increases the blood calcium level, in addition, this can also be determined if Ca^{2+} level is increasing Ca^{2+} level in blood.

35. (a) Thymus acts as one of T cell differentiation. The thymus increases primarily in the size and activity and then it reduces gradual involution (shrinkage) in puberty and old age. It is present as a small mass of lymph tissue covered with a fibrous capsule in between the sternum.

36. (a) Thymosin is a polypeptide hormone produced by thymus gland that lowers the level of calcium in blood and increases the formation of bone.

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37. **(b)** In frogs growth and metamorphosis (development of frog from tadpole stage to adult stage) is regulated by thyroxine gland. Thyroxine secreted from thyroid gland. It stimulates the consumption of oxygen by metabolically active tissues and also increase oxidation of glucose. Hence addition of trace of thyroxine or iodine in water containing tadpoles will hastens their metamorphosis.

38. **(b)** Diabetes mellitus, a complex disorder, is associated with loss of glucose through urine (glycosuria) and formation of harmful compounds known as ketone bodies in urine (ketonuria).

39. **(b)** Diabetes insipidus is caused due to hyporelease of ADH from posterior pituitary.
Graves' disease is caused due to excess secretion of thyroid hormones (T3 & T4).
Addison's disease is caused due to hyposecretion of hormone from adrenal cortex.
Diabetes mellitus is caused due to hyposecretion of insulin from β-cells of pancreas.

40. **(a)** Adrenal cortex secretes mineralocorticoids like aldosterone which increase the reabsorption of Na^+ and water from renal tubule that prevent diuresis.

41. **(d)** Glucagon is associated with hyperglycemia. Insulin acts on hepatocytes and adipocytes. Insulin is associated with hypoglycemia.

42. **(c)** Insulin deficiency leads to disorder called diabetes mellitus.
- Hypersecretion or hyposecretion of thyroxine can be associated with enlargement of thyroid gland called goitre.
- Deficiency of corticoids (Glucocorticoid + mineralocorticoid) leads to Addison's disease.
- Growth hormone hypersecretion in adults leads to acromegaly.

43. **(d)** Graves' disease is caused due to hypersecretion of thyroid gland.

44. **(a)** Epinephrine is secreted by adrenal medulla for meeting and emergency as in cold, emotional stress, pain, anger and fear. This is its endocrine role. Dopamine (neurotransmitter) is an intermediate in the biosynthesis of adrenaline from the tyrosine and phenylalanine.

45. **(a)** Mineralocorticoids regulate the balance of water and electrolytes in our body.
E.g., Aldosterone

46. **(d)** Adrenal medulla releases epinephrine and norepinephrine in response to stress of any kind and during emergency. That is why they are called emergency hormone.

47. **(b)** Adrenaline secreted by the adrenal medulla. While adrenal cortex secretes aldosterone and cortisol. So, if there is an injury in adrenal cortex there will be no effect on secretion of adrenaline.

48. **(b)** Adrenal medulla secretes two hormones called adrenaline and noradrenaline. These hormones increase alertness, pupilary dilation, heart beat and rate of respiration. It secretes during emergency.

49. **(d)** Adrenal medulla secretes two hormones called adrenaline and noradrenaline. These hormones increase alertness, dilation of blood vessels, increased oxygen consumption and glucogenesis.

50. **(b)** Cortisol is the glucocorticoid secreted by adrenal cortex. They are involved in carbohydrate metabolism.

51. **(d)** Insulin mainly acts on hepatocytes & adipocytes & enhances cellular glucose uptake & utilisation. In deficiency of this hormone, glucose starts to accumulate in blood & lead to a disorder called diabetes mellitus.

52. **(d)** Reduced storage of glycogen is a condition of diabetes. Diabetes can cause severe hair loss in some individuals in elder aged.

53. **(b)** Insulin & growth hormone both promote lipolysis. Treatment with both hormone is followed by reduced protein oxidation and enhanced energy expenditure.

54. **(a)** Thyroxine is a derivative of amino acid tyrosine. Melanin is synthesised from tyrosine in melanocytes. Adrenaline is also formed by tyrosine.

55. **(c)** Insulin is a peptide hormone secreted by β - cells of islets of langerhans in pancreas.

56. **(a)** Insulin decreases the level of glucose in the blood while cortisol (secreted by middle region of adrenal cortex) increases the blood-glucose level by converting proteins and fats into carbohydrates which are, in turn, converted to glucose.

57. **(b)** Cholecystokinin (CCK), a hormone secreted by I-cells of the upper small intestine. It acts on both pancreas and gall bladder and stimulates the secretion of pancreatic enzymes and bile juice, respectively.
Gastric inhibitory peptide (GIP) is secreted by K-cells of the small intestine. It acts to decrease gastrin and gastric dependent acid secretion from the parietal cells of the stomach (gastric glands).
Atrial natriuretic factor (ANF) is a peptide hormone secreted by atrial wall of our heart. It decreases blood pressure.
Anti-diuretic hormone (ADH) causes the kidneys to return more water to the blood and thus decrease the urine volume.

58. **(c)** The juxtaglomerular cells of kidney produce a peptide hormone called erythropoietin which stimulates erythropoiesis (formation of RBC).

59. **(c)** Placenta – Secretes human chorionic gonadotropin hormone during pregnancy.
Corpus luteum – Secretes large amounts of progesterone for the maintenance of endometrium.
Leydig cells – Responsible for the secretion of androgens.
Ovary – Secretes female hormones estrogen and progesterone.

60. **(d)** Sertoli cells secrete another protein, called inhibin, which suppresses FSH synthesis.
Relaxin facilitates parturition by softening the connective tissue of the pubic symphysis.

61. **(a)** Pancreatic juice and bicarbonate secretion is principally regulated by hormones cholecystokinin and secretin within the alimentary canal.

62. **(d)** Endocrine cells present in different parts of gastrointestinal tract secrete major peptide hormones. E.g., GIP, gastrin, secretin. Releasing and inhibitory hormone like thyrotropin releasing hormone and dopamine respectively are produced by the hypothalamus. Organs in the body like gastrointestinal tract produce peptide hormones, heart produces atrial natriuretic factor (ANF) hormone, kidney produces erythropoietin and liver produce angiotensinogen.

63. **(a)** Oxytocin is released by the anterior pituitary. It acts on the smooth muscles and stimulates their contraction.

64. **(b)** Ovary: Estrogen hormone
Alpha cells of Pancreas: Glucagon in blood sugar
Anterior Pituitary: Growth hormone over secretion causes gigantism

65. **(c)** Neurohypophysis (pars nervosa) also known as posterior pituitary, stores and releases two hormones called oxytocin and vasopressin, which are actually synthesised by the hypothalamus and are transported axonally to neurohypophysis.
Vasopressin acts mainly at the kidney and stimulates resorption of water and electrolytes by the distal tubules and thereby reduces loss of water through urine (diuresis). Hence, it is also called as anti-diuretic hormone (ADH).

66. **(d)** Glucagon is secreted by α - cells of islet of Langerhans.

67. **(c)** In between the seminiferous tubules in the connective tissue of testes, there are present small groups of rounded interstitial or Leydig cells which secrete androgens (e.g., testosterone), i.e., male sex hormones.

68. **(b)** Vasopressin (ADH) secreted by posterior pituitary that maintain water balance in the body and glucagon is secreted by α - cells of Islet of Langerhans. Prolactin is secreted by anterior pituitary.

69. **(c)** Bullock has low level of testosterone as compared to a bull. High level of testosterone increases aggressiveness.

70. **(b)** In males, FSH regulates spermatogenesis. FSH stimulates Sertoli cells of the testis are to secrete androgen binding protein (ABP) that concentrates testosterone.

71. **(d)** Pituitary gland, a small gland under the brain, makes luteinizing hormone. It plays an important role in sexual development and function. It also stimulate the ovaries to release an egg.

72. **(d)** Pharmaceutical industry has great interest in biotransformation of steroids for the production of steroid hormones. Mostly progesterone is used for transformation.

73. **(c)** Anal glands carry some smelly fluid. Dogs have a pair of these small glands on either side of anus.

74. **(c)** Secretin and cholecystokinin are secreted by Brunner's glands present in duodenum where most of the digestion takes place.

75. **(a)** High level of luteinising hormone (LH) results in ovulation which is followed by transformation of remaining parts of Graafian follicle into corpus luteum.

76. **(a)** CCK stimulates contractions in the smooth muscle of the gall bladder. Gall bladder muscular contractions control the flow of bile into the duodenum.

77. **(d)** Prolactin (PRL) is secreted by pars distalis (anterior lobe of pituitary gland). It stimulates the secretion of milk in mammary glands of female. Oxytocin controls the milk ejection from mammary gland.

78. **(a)** Enterogastrone is hormone secreted by mucosa of duodenum, where it inhibits gastric movements and secretions by blocking production or activity of gastrin.

79. **(d)** Leydig cells are situated in intercellular spaces of seminiferous tubules of testis. They secrete testosterone, male sex hormones.

80. **(b,d)** Secretin & cholecystokinin stimulates delivery into small intestine of digestive enzymes from pancreas & bile from gall bladder.

81. **(c)** FSH binds to receptors and activates a second messenger system (such as cyclic AMP) without entering the cell itself. FSH is a peptide hormone that cannot directly pass through the membranes.

82. **(a)** On the basis of their chemical nature, hormones can be divided into groups :
(i) peptide, polypeptide, protein hormones (e.g., insulin, glucagon, pituitary hormones, hypothalamic hormones, etc.)
(ii) steroids (e.g., cortisol, testosterone, estradiol and progesterone)
(iii) iodothyronines (thyroid hormones)
(iv) amino-acid derivatives (e.g., epinephrine)

83. **(b)** Steroid hormones directly enter into the cell and bind with intracellular receptors in nucleus to form hormone receptor complex. Hormone receptor complex interacts with the genome and regulate gene expression or chromosome function.

84. **(a)** Epinephrine or adrenaline is tryptophan (amino acid) derived hormone that plays an important role in fight or flight response.

85. **(c)** Insulin acts mainly on hepatocytes and adipocytes (cells of adipose tissue), and enhances cellular glucose uptake and utilisation. As a result, there is a rapid movement of glucose from blood to hepatocytes and adipocytes resulting in decreased blood glucose levels (hypoglycemia).

86. **(a)** The amino acid tryptophan is the precursor for the synthesis of melatonin and serotonin.

87. **(d)** Being a peptide hormone, FSH regulates cellular metabolism by binding with the membrane bound receptors present on the cells of the ovary. After interacting with the membrane-bound receptors, it generates a secondary messenger such as a cyclic AMP or Ca^{++}. FSH stimulates the secretion of estrogen from the ovary.

88. **(a)** Steroids such as cortisol, testosterone, estradiol and progesterone can pass through the cell membrane of the target cell and bind to a receptor inside it (mostly in the nucleus).

89. **(c)** Complex proteins in striated muscles: Troponin and myosin.

90. **(d)** Second messenger are cyclic AMP, IP_3, Ca^{+2} & cGMP.

91. **(d)** Epinephrine or adrenaline is a peptide hormone derived from amino acid tyrosine.

92. **(a)** Malathione is an insect specific Acetyl choline esterase (AChE) inhibitor which is used by citrus crop producers to fight against mediterranean fruit fly as it does not bind to human isoform of the enzyme.

93. **(b)** Follicular cells of thyroid gland secrete two hormones, thyroxine and triiodothyronine, which is stored in the extracelluar space around them and then hormones are released into the blood.

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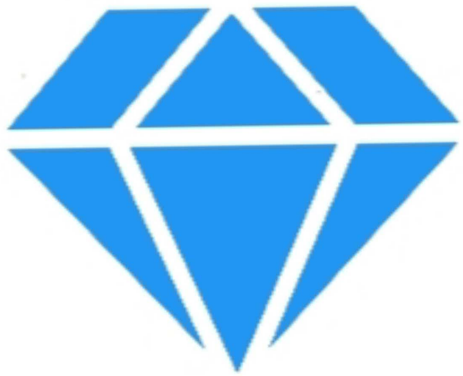
TEAM Kohinoor

Class - XII



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CHAPTER 1

Sexual Reproduction in Flowering Plants

Flower and Pre-fertilisation

1. Large, colourful, fragrant flowers with nectar are seen in: *(2023)*
   a. wind pollinated plants b. insect pollinated plants
   c. bird pollinated plants d. bat pollinated plants

2. What is the function of tassels in the corn cob? *(2023)*
   a. To protect seeds b. To attract insects
   c. To trap pollen grains d. To disperse pollen grains

3. In which of the following sets of families, the pollen grains are viable for months? *(2023-Manipur)*
   a. Solanaceae, Poaceae and Liliaceae
   b. Brassicaceae, Liliaceae and Poaceae
   c. Rosaceae, Liliaceae and Poaceae
   d. Leguminosae, Solanaceae and Rosaceae

4. Transfer of pollen grains from anther to stigma of another flower of same plant is known as: [MR*] *(2023-Manipur)*
   a. Geitonogamy b. Xenogamy
   c. Autogamy d. Cleistogamy

5. In angiosperms the correct sequence of events in formation of female gametophyte in the ovule is: [MR*] *(2023-Manipur)*
   A. 3 successive free nuclear divisions in functional megaspore.
   B. Degeneration of 3 megaspores.
   C. Meiotic division in megaspore mother cell.
   D. Migration of 3 nuclei towards each pole.
   E. Formation of wall resulting in seven celled embryo sac.
   Choose the **correct** answer from the options given below:
   a. (A), (B), (C), (D), (E) b. (C), (E), (A), (D), (B)
   c. (B), (C), (A), (D), (E) d. (C), (B), (A), (D), (E)

6. To ensure that only the desired pollens fall on the stigma in artificial hybridization process, [MR*] *(2022 Re)*
   A. the female flower buds of plant producing unisexual flowers need not be bagged.
   B. there is no need to emasculate unisexual flowers of selected female parent.
   C. emasculated flowers are to be bagged immediately after cross pollination.
   D. emasculated flowers are to be bagged after removal of anthers bisexual flowers, showing protogyny are never selected for cross.
   E. bisexual flowers, showing protogyny are never selected for cross.
   Choose the correct answer from the options given below:
   a. (A), (D) and (E) only b. (A), (B) and (C) only
   c. (B), (C) and (D) only d. (B), (C) and (E) only

7. In general the egg apparatus of embryo sac in angiosperm consists of [MR*] *(2022 Re)*
   a. One egg cell, two synergids, two antipodal cells, two Polar nuclei
   b. One egg cell, two synergids, three antipodal cells, two Polar nuclei
   c. One egg cell, two synergids, two antipodal cells, three Polar nuclei
   d. One egg cell, three synergids, two antipodal cells, two Polar nuclei

8. Given below are two statements: [MR*] *(2022)*
   Statement I: Cleistogamous flowers are invariably autogamous
   Statement II: Cleistogamy is disadvantageous as there is no chance for cross pollination
   In the light of the above statements, choose the correct answer from the options given below:
   a. Statement I is incorrect but Statement II is correct
   b. Both Statement I and Statement II are correct
   c. Both statement I and statement II are incorrect
   d. Statement I is correct but Statement II is incorrect

9. Identify the **incorrect** statement related to Pollination: *(2022)*
   a. Moths and butterflies are the most dominant pollinating agents among insects
   b. Pollination by water is quite rare in flowering plants
   c. Pollination by wind is more common amongst abiotic pollination
   d. Flowers produce foul odours to attract flies and beetles to get pollinated

10. A typical angiosperm embryo sac at maturity is: *(2021)*
    a. 7- nucleate and 8-celled b. 7- nucleate and 7-celled
    c. 8- nucleate and 8- celled d. 8-nucleate and 7- celled

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11. The term used for transfer of pollen grains from anthers of one plant to stigma of different plant which, during pollination, brings genetically different types of pollen grains to stigma, is: *(2021)*
a. Geitonogamy b. Chasmogamy
c. Cleistogamy d. Xenogamy

12. In some members of which of the following pairs of families, pollen grains retain their viability for months after release ? *(2021)*
a. Poaceae ; Leguminosae b. Poaceae ; Solanaceae
c. Rosaceae ; Leguminosae d. Poaceae ; Rosaceae

13. The plant parts which consist of two generations one within the other: *(2020)*
1. Pollen grains inside the anther
2. Germinated pollen grain with two male gametes
3. Seed inside the fruit
4. Embryo sac inside the ovule
a. (1), (2) and (3) b. (3) and (4)
c. (1) and (4) d. (1) only

4. In water hyacinth and water lily, pollination takes place by: *(2020)*
a. Water currents only b. Wind and water
c. Insects and water d. Insects or wind

5. The body of the ovule is fused within the funicle at: *(2020)*
a. Micropyle b. Nucellus
c. Chalaza d. Hilum

16. Which of the following is incorrect for wind-pollinated plants? *(2020-Covid)*
a. Many ovules in each ovary
b. Flowers are small and not brightly coloured
c. Pollen grains are light and non-sticky
d. Well exposed stamens and stigma

17. Which of the following has proved helpful in preserving pollen as fossils? *(2018)*
a. Pollenkitt b. Cellulosic intine
c. Oil content d. Sporopollenin

18. Pollen grains can be stored for several years in liquid nitrogen having a temperature of: *(2018)*
a. –120°C b. –80°C
c. –196°C d. –160°C

19. Functional megaspore in an angiosperm develops into: *(2017-Delhi)*
a. Ovule b. Endosperm
c. Embryo sac d. Embryo

20. A dioecious flowering plant prevents both: [MR*] *(2017-Delhi)*
a. Autogamy and xenogamy
b. Autogamy and geitonogamy
c. Geitonogamy and xenogamy
d. Cleistogamy and xenogamy

21. Flowers which have single ovule in the ovary and are packed into inflorescence are usually pollinated by: *(2017-Delhi)*
a. Water b. Bee
c. Wind d. Bat

22. Attractants and rewards are required for: *(2017-Delhi)*
a. Anemophily b. Entomophily
c. Hydrophily d. Cleistogamy

23. The ovule of an angiosperm is technically equivalent to: *(2016 - II)*
a. Megaspore mother cell b. Megaspore
c. Megasporangium d. Megasporophyll

24. Pollination in water hyacinth and water lily is brought about by the agency of: *(2016 - II)*
a. Birds b. Bats
c. Water d. Insects or wind

25. In majority of angiosperms: *(2016 - II)*
a. Reduction division occurs in the megaspore mother cell
b. A small central cell is present in the embryo sac
c. Egg has a filiform apparatus
d. There are numerous antipodal cells

26. Which of the following statements is not correct? [MR*] *(2016 - I)*
a. Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.
b. Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers.
c. Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.
d. Some reptiles have also been reported as pollinators in some plant species.

27. Which one of the following statements is not true? *(2016 - I)*
a. Tapetum helps in the dehiscence of anther
b. Exine of pollen grains is made up of sporopollenin
c. Pollen grains of many species cause severe allergies
d. Stored pollen in liquid nitrogen can be used in the crop breeding programmes

28. Proximal end of the filament of stamen is attached to the: *(2016 - I)*
a. Anther b. Connective
c. Placenta d. Thalamus or petal

29. Which one of the following may require pollinators but is genetically similar to autogamy? *(2015)*
a. Apogamy b. Cleistogamy
c. Geitonogamy d. Xenogamy

30. Which of the following are important floral rewards to the animal pollinators? *(2015)*
a. Floral fragrance and calcium crystal
b. Protein pellicle and stigmatic exudates
c. Colour and large size of flower
d. Nectar and pollen grains

31. In angiosperms, microsporogenesis and megasporogenesis: *(2015 Re)*
a. Form gametes without further divisions
b. Involve meiosis
c. Occur in ovule
d. Occur in anther

32. Filiform apparatus is characteristic feature of: *(2015 Re)*
a. Nucellar embryo b. Aleurone cell
c. Synergids d. Generative cell

33. Male gametophyte in angiosperms produces: *(2015 Re)*
a. Single sperm and a vegetative cell
b. Single sperm and two vegetative cells
c. Three sperms
d. Two sperms and a vegetative cell

34. Which one of the following statements is not true? *(2015 Re)*
a. The flowers pollinated by flies and bats secrete foul odor to attract them
b. Honey is made by bees by digesting pollen collected from flowers
c. Pollen grains are rich in nutrients, and they are used in the form of tablets and syrups
d. Pollen grains of some plants cause severe allergies and bronchial afflictions in some people

35. Pollen tablets are available in the market for: *(2014)*
a. *Ex situ* conservation b. *In vitro* fertilisation
c. Breeding programmes d. Supplementing food

36. Function of filiform apparatus is to: *(2014)*
a. Guide the entry of pollen tube
b. Recognise the suitable pollen at stigma
c. Stimulate division of generative cell
d. Produce nectar

37. Geitonogamy involves: *(2014)*
a. Fertilisation of a flower by the pollen from a flower of another plant belonging to a distant population
b. Fertilisation of a flower by the pollen from another flower of the same plant
c. Fertilisation of a flower by the pollen from the same flower
d. Fertilisation of a flower by the pollen from a flower of another plant in the same population

38. Which one of the following statements is correct? *(2013)*
a. Tapetum nourishes the developing pollen
b. Hard outer layer of pollen is called intine
c. Sporogenous tissue is haploid
d. Endothecium produces the microspores

39. Advantage of cleistogamy is: *(2013)*
a. Vivipary
b. Higher genetic variability
c. More vigorous offspring
d. No dependence on pollinators

40. Megasporangium is equivalent to: *(2013)*
a. Ovule b. Embryo sac
c. Fruit d. Nucellus

41. Plants with ovaries having only one or a few ovules, are generally pollinated by: *(2012 Mains)*
a. Bees b. Butterflies
c. Birds d. Wind

42. Which one of the following statements is wrong? *(2012 Mains)*
a. When pollen is shed at two-celled stage, double fertilisation does not take place
b. Vegetative cell is larger than generative cell
c. Pollen grains in some plants remain viable for months
d. Intine is made up of cellulose and pectin.

43. What is the function of germ pore? *(2012 Mains)*
a. Emergence of radicle
b. Absorption of water for seed germination
c. Initiation of pollen tube
d. Release of male gametes

44. Both, autogamy and geitonogamy are prevented in: *(2012 Pre)*
a. Maize b. Papaya
c. Cucumber d. Castor

45. Even in absence of pollinating agents seed-setting is assured in: *(2012 Pre)*
a. Fig b. *Commellina*
c. *Zostera* d. *Salvia*

46. The gynoecium consists of many free pistils in flowers of: *(2012 Pre)*
a. *Michelia* b. *Aloe*
c. Tomato d. *Papaver*

47. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is: [MR*] *(2012 Pre)*
a. Cellulose b. Cuticle
c. Sporopollenin d. Lignin

48. In angiosperms, functional megaspore develops into: *(2011 Mains)*
a. Endosperm b. Pollen sac
c. Embryo sac d. Ovule

49. In which one of the following pollination is autogamous? *(2011 Pre)*
a. Cleistogamy b. Geitonogamy
c. Xenogamy d. Chasmogamy

50. Wind pollination is common in: *(2011 Pre)*
a. *Orchids* b. Legumes
c. Lilies d. Grasses

51. Filiform apparatus is a characteristic feature of: *(2011 Pre)*
a. Zygote b. Suspensor
c. Egg d. Synergid

52. Wind pollinated flowers are: *(2010 Pre)*
a. Small, brightly coloured, producing large number of pollen grains
b. Small, producing large number of dry pollens
c. Large producing abundant nectar and pollen
d. Small producing nectar and dry pollen

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53. Which pair has haploid nature? *(2008)*
a. Nucellus and antipodal cells
b. Egg nucleus and secondary nucleus
c. Megaspore mother cell and antipodal cells
d. Egg cell and antipodal cells

54. Which one is resistant to enzyme action? *(2008)*
a. Pollen exine b. Leaf cuticle
c. Cork d. Wood fibre

55. What does filiform apparatus do at the entrance into ovule? [MR*] *(2008)*
a. Brings about opening of pollen tube
b. Guides pollen tube from synergid to egg
c. Helps in entry of pollen tube into synergid
d. Prevents entry of more than one pollen tube into embryo sac

56. Unisexuality of flowers prevents: *(2008)*
a. Geitonogamy but not xenogamy
b. Autogamy and geitonogamy
c. Autogamy but not geitonogamy
d. Both geitonogamy and xenogamy

57. Which one is surrounded by callose wall? *(2007)*
a. Male gamete b. Pollen grain
c. Egg d. Microspore mother cell

58. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is: *(2004)*
a. Campylotropous b. Anatropous
c. Orthotropous d. Hemitropous

59. In a flowering plant, archesporium gives rise to: *(2003)*
a. Only the wall of the sporangium
b. Both wall and the sporogenous cells
c. Wall and the tapetum
d. Only tapetum and sporogenous cells

60. In angiosperm, all the four microspores of tetrad are covered by a layer which is formed by: *(2002)*
a. Pectocellulose b. Callose
c. Cellulose d. Sporopollenin

61. What is the direction of micropyle in anatropous ovule? *(2002)*
a. Upward b. Downward
c. Right d. Left

62. Anemophily type of pollination is found in: *(2001)*
a. *Salvia* b. Bottle brush
c. *Vallisneria* d. Coconut

63. In grasses what happens in microspore mother cell for the formation of mature pollen grains? *(2001)*
a. One meiotic and two mitotic divisions
b. One meiotic and one mitotic divisions
c. One meiotic division
d. One mitotic division

64. Eight nucleated embryo sac is a: *(2000)*
a. Only monosporic b. Only bisporic
c. Only tetrasporic d. Any of the above

65. Ornithophilly takes place in: *(1999)*
a. Yellow flower having nectaries
b. Scented flower
c. Rower with charming colour
d. Modified corolla tube

66. In angiosperm, characters of flowers are used in classification because: *(1998)*
a. Characters of flowers are conservative
b. Flowers are large
c. Flowers are attractive
d. None of the above

67. If there are 4 cells in anthers, what will be the number of pollen grains? *(1996)*
a. 16 b. 12
c. 8 d. 4

68. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains? *(1995)*
a. 75 b. 100
c. 25 d. 50

69. When pollen of a flower is transferred to the stigma of another flower of the same plant, the pollination is referred to as: *(1994)*
a. Autogamy b. Geitonogamy
c. Xenogamy d. Allogamy

70. Embryo sac represents: *(1994)*
a. Megaspore b. Megagametophyte
c. Megasporophyll d. Megagamete

71. Number of meiotic divisions required to produce 200/400 seeds of pea would be: *(1993)*
a. 200/400 b. 400/800
c. 300/600 d. 250/500

72. Ovule is straight with funiculus, embryo sac, chalaza and micropyle lying on one straight line. It is? *(1993)*
a. Orthotropous b. Anatropous
c. Campylotropous d. Amphitropous

73. Point out the odd one: *(1991)*
a. Nucellus b. Embryo sac
c. Micropyle d. Pollen grain

74. Which of the following pair have haploid structures? *(1991)*
a. Nucellus and antipodal cells
b. Antipodal cells and egg cell
c. Antipodal cells and megaspore mother cell
d. Nucellus and primary endosperm nucleus

75. Embryo sac occurs in: *(1991)*
a. Embryo b. Axis part of embryo
c. Ovule d. Endosperm

76. Pollination occurs in: *(1991)*
a. Bryophytes and angiosperms
b. Pteridophytes and angiosperms
c. Angiosperms and gymnosperms
d. Anglosperms and fungi

77. Vivipary is characteristic of: (1990)
a. Mesophytes b. Xerophytes
c. Hydrophytes d. Halophytes

78. Entry of pollen tube through micropyle is: *(1990)*
a. Chalazogamy b. Mesogamy
c. Porogamy d. Pseudogamy

79. Female gametophyte of angiosperms is represented by: *(1990)*
a. Ovule b. Megaspore mother cell
c. Embryo sac d. Nucellus

80. Male gametophyte of angiosperms/monocots is: *(1990)*
a. Microsporangium b. Nucellus
c. Microspore d. Stamen

81. Which is correct? *(1989)*
a. Gametes are invariably haploid
b. Spores are invariably haploid
c. Gametes are generally haploid
d. Both spores and gametes are invariably haploid

82. Total number of meiotic divisions required for forming 100 zygotes/100 grains of wheat is: *(1988)*
a. 100 b. 75
c. 125 d. 50

83. Male gametophyte of angiosperms is shed at: *(1988)*
a. Four celled pollen grain
b. Three celled pollen grain
c. Microspore mother cell
d. Anther

Double Fertilisation

84. Double fertilisation is: *(2018)*
a. Fusion of two male gametes of a pollen tube with two different eggs
b. Fusion of one male gamete with two polar nuclei
c. Fusion of two male gametes with one egg
d. Syngamy and triple fusion

85. In angiosperms, pollen tube liberate their males gametes into the: *(2002)*
a. Central cell b. Antipodal cells
c. Egg cell d. Synergids

86. Which of the following is without exception in Angiosperms? *(2002)*
a. Presence of vessels b. Double fertilisation
c. Secondary growth d. Autotrophic nutrition

87. Endosperm is formed during the double fertilisation by: *(2000)*
a. Two polar nuclei and one male gamete
b. One polar nuclei and One male gamete
c. Ovum and male gamete
d. Two polar nuclei and two male gametes

88. Endosperm in Gymnosperm is: *(1999)*
a. Polyploid b. Diploid
c. Triploid d. Haploid

89. If an angiospermic male plant is diploid and female plant tetraploid, the ploidy level of endosperm will be: *(1997)*
a. Tetraploid b. Pentaploid
c. Haploid d. Triploid

90. The role of double fertilisation in angiosperm is to produce: *(1996)*
a. Cotyledons b. Endocarp
c. Endosperm d. Hormones

91. Double fertilisation is characteristic of: *(1993)*
a. Angiosperms b. Anatropous
c. Gymnosperms d. Bryophytes

92. Double fertilisation is fusion of: *(1991)*
a. Two eggs
b. Two eggs and polar nuclei with pollen nuclei
c. One male gamete with egg and other with synergid
d. One male gamete with egg and other with secondary nucleus

93. Sperm and egg nuclei fuse due to: *(1990)*
a. Base pairing of their DNA and RNA
b. Formation of hydrogen bonds
c. Mutual attraction due to differences in electrical charges
d. Attraction of their protoplasts

94. Generative cell was destroyed by laser but a normal pollen tube was still formed because: *(1989)*
a. Vegetative cell is not damaged
b. Contents of killed generative cell stimulate pollen growth
c. Laser beam stimulates growth of pollen tube
d. The region of emergence of pollen tube is not harmed

95. Double fertilisation and triple fusion were discovered by: *(1988)*
a. Hofmeister b. Nawaschin and Guignard
c. Leeuwenhoek d. Strasburger

Post Fertilisation

96. In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are: [MR*] *(2023)*
a. Synergids, antipodals and Polar nuclei
b. Synergids, Primary endosperm nucleus and zygote
c. Antipodals, synergids, and primary endosperm nucleus
d. Synergids, Zygote and Primary endosperm nucleus

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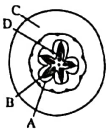
97. The residual persistent part which forms the perisperm in the seeds of beet is: *(2022 Re)*
a. Integument b. Calyx
c. Endosperm d. Nucellus

98. Which part of the fruit, labelled in the given figure makes it a false fruit? *(2022)*



a. D → Seed b. A → Mesocarp
c. B → Endocarp d. C → Thalamus

99. In some plants thalamus contributes to fruit formation. Such fruits are termed as *(2020-Covid)*
a. Aggregate fruits b. True fruits
c. Parthenocarpic fruit d. False fruits

100. Which one of the following statements regarding post-fertilization development in flowering plants is incorrect? *(2019)*
a. Ovary develops into fruit
b. Zygote develops into embryo
c. Central cell develops into endosperm
d. Ovules develop into embryo sac

101. Persistent nucellus in the seed is known as *(2019)*
a. Chalaza b. Perisperm
c. Hilum d. Tegmen

102. What is the fate of the male gametes discharged in the synergid? *(2019)*
a. One fuses with egg other(s) degenerate(s) in the synergid.
b. All fuse with the egg.
c. One fuses with the egg, other(s) fuse(s) with synergid nucleus.
d. One fuses with the egg and other fuses with central cell nuclei.

103. The hollow foliar structure in a wheat embryo that encloses the shoot apex and a few leaf primordia is called: *(2017-Gujarat)*
a. Coleoptile b. Coleorrhiza
c. Epicotyl d. Hypocotyl

104. Cotyledon of maize grain is called: *(2016 - I)*
a. Plumule b. Coleorhiza
c. Coleoptile d. Scutellum

105. The coconut water from tender coconut represents: *(2016 - I)*
a. Endocarp b. Fleshy mesocarp
c. Free nuclear proembryo d. Free nuclear endosperm

106. The hilum is a scar on the: *(2015)*
a. Fruit, where style was present
b. Seed, where micropyle was present
c. Seed, where funicle was attached
d. Fruit, where it was attached to pedicel

107. The wheat grain has an embryo with one, large, shield-shaped cotyledon known as: *(2015 Re)*
a. Coleorrhiza b. Scutellum
c. Coleoptile d. Epiblast

108. Which one of the following fruits is parthenocarpic? *(2015 Re)*
a. Apple b. Jackfruit
c. Banana d. Brinjal

109. Coconut water from a tender coconut is: [MR*] *(2015 Re)*
a. Free nuclear endosperm
b. Innermost layers of the seed coat
c. Degenerated nucellus
d. Immature embryo

110. Non-Albuminous seed is produced in: *(2014)*
a. Pea b. Maize
c. Castor d. Wheat

111. Perisperm differs from endosperm in: *(2013)*
a. Its formation by fusion of secondary nucleus with several sperms
b. Being a haploid tissue
c. Having no reserve food
d. Being a diploid tissue

112. The coconut water and the edible part of coconut are equivalent to: *(2012 Pre)*
a. Embryo b. Endosperm
c. Endocarp d. Mesocarp

113. Arrangement of nuclei in normal dicot embryo sac is: *(2006)*
a. 3 + 3 + 2 b. 2 + 4 + 2
c. 3 + 2 + 3 d. 2 + 3 + 3

114. Pollen tube discharges its male gametes into: *(2005)*
a. Egg b. Healthy synergid
c. Degenerating synergid d. Central cell

115. When a diploid female plant is crossed with a tetraploid male, the ploidy of endosperm cells in the resulting seed is: *(2004)*
a. Pentaploidy b. Diploidy
c. Triploidy d. Tetraploidy

116. Which is correct pair for edible part? *(2001)*
a. Tomato - Thalamus b. Maize - Cotyledons
c. Guava - Mesocarp d. Date palm - Pericarp

117. Study of formation, growth and development of new individual from an egg is: *(1993)*
a. Apomixis b. Embryology
c. Embryogeny d. Cytology

118. Perisperm is: *(1989, 88)*
a. Remnant of endosperm
b. Persistent nucellus
c. Peripheral part of endosperm
d. Disintegrated secondary nucleus

119. Micropyle of seed is involved in the passage of: *(1988)*
a. Male gamete b. Pollen tube
c. Water d. Gases

Apomixis and Polyembryony

120. Which of the following can be expected if scientists succeed in introducing apomictic gene varieties of crops [MR*] *(2022 Re)*
a. There will be segregation of the desired characters only in the progeny
b. Polyembryony will be seen and each seed will produce many plantlets
c. Seeds of hybrid plants will show longer dormancy
d. Farmers can keep on using the seeds produced by the hybrids to raise new crop year after year

121. Seed formation without fertilisation in flowering plants involves the process of: *(2016 - I)*
a. Sporulation b. Budding
c. Somatic hybridisation d. Apomixis

122. What is common between vegetative reproduction and apomixis? *(2011 Mains)*
a. Both occur round the year
b. Both produce progeny identical to the parent
c. Both are applicable to only dicot plants
d. Both bypass the flowering phase

123. Nucellar polyembryony is reported in species of: *(2011 Pre)*
a. *Brassica* b. *Citrus*
c. *Gossypium* d. *Triticum*

124. Apomictic embryos in *Citrus* arise from: [MR] *(2010 Pre)*
a. Maternal sporophytic tissue in ovule
b. Antipodal cells
c. Diploid cells
d. Synergids

125. In a type of apomixis known as adventitive embryony, embryos develop directly from: *(2005)*
a. Nucellus or integument
b. Zygote
c. Synergids or antipodals of embryo sac.
d. Accessory embryo sacs in the ovule

126. Adventive embryony in *Citrus* is due to: *(2001)*
a. Nucellus b. Integuments
c. Zygotic embryo d. Fertilised egg

127. The polyembryony commonly occurs in: *(1995)*
a. Tomato b. Potato
c. *Citrus* d. Turmeric

128. Nucellar embryo is: *(1989)*
a. Amphimictic haploid b. Amphimictic diploid
c. Apomictic haploid d. Apomictic diploid

129. Development of an organism from female gamete/egg without involving fertilisation is: *(1989)*
a. Adventitive embryony b. Polyembryony
c. Parthenocarpy d. Parthenogenesis

130. Parthenogenesis is: *(1988)*
a. Development of embryo without fertilisation
b. Development of fruit without fertilisation
c. Development of fruit without hormones
d. Development of embryo from egg without fertilisation

131. Formation of gametophyte directly from sporophyte without meiosis is: *(1988)*
a. Apospory b. Apogamy
c. Parthenogenesis d. Amphimixis

132. Prothallus (gametophyte) gives rise to fern plant (sporophyte) without fertilisation. It is: *(1988)*
a. Apospory b. Apogamy
c. Parthenocarpy d. Parthenogenesis

Answer Key

1. (b)	2. (c)	3. (d)	4. (a)	5. (d)	6. (c)	7. (b)	8. (b)	9. (a)	10. (d)
11. (d)	12. (c)	13. (c)	14. (d)	15. (d)	16. (a)	17. (d)	18. (c)	19. (c)	20. (b)
21. (c)	22. (b)	23. (c)	24. (d)	25. (a)	26. (a)	27. (a)	28. (d)	29. (c)	30. (d)
31. (b)	32. (c)	33. (d)	34. (b)	35. (d)	36. (a)	37. (b)	38. (a)	39. (d)	40. (a)
41. (d)	42. (a)	43. (c)	44. (b)	45. (b)	46. (a)	47. (c)	48. (c)	49. (a)	50. (d)
51. (d)	52. (b)	53. (d)	54. (a)	55. (b)	56. (c)	57. (d)	58. (d)	59. (b)	60. (b)
61. (b)	62. (d)	63. (b)	64. (d)	65. (a)	66. (a)	67. (a)	68. (c)	69. (b)	70. (b)
71. (d)	72. (a)	73. (d)	74. (b)	75. (c)	76. (c)	77. (d)	78. (c)	79. (c)	80. (c)
81. (a)	82. (c)	83. (b)	84. (d)	85. (d)	86. (b)	87. (a)	88. (d)	89. (b)	90. (c)
91. (a)	92. (d)	93. (d)	94. (a)	95. (b)	96. (d)	97. (d)	98. (d)	99. (d)	100. (d)
101. (b)	102. (d)	103. (a)	104. (d)	105. (d)	106. (c)	107. (b)	108. (c)	109. (a)	110. (a)
111. (d)	112. (b)	113. (c)	114. (c)	115. (d)	116. (d)	117. (b)	118. (b)	119. (c)	120. (d)
121. (d)	122. (b)	123. (b)	124. (a)	125. (a)	126. (a)	127. (c)	128. (d)	129. (d)	130. (d)
131. (a)	132. (b)								

Explanations

1. **(b)** Majority of insect-pollinated flowers are large, colorful, fragrant flowers and rich in nectar. These characteristics off were attract insect and thus help in pollination.

2. **(c)** Wind pollinated flower eg. *Zea mays* (maize) have non-essential whorls such as calyx, corolla, bracts and bracteoles are not showy. Flowers are devoid of scent and nectar. The tassels represent the stigma and style. Pollen grains are dry, very small sized, non-sticky and unwettable, so that they can be carried by wind to the long distances. Stigma is hairy, feathery that catches the wind borne pollens.

3. **(d)** Leguminoseae, Solanaceae and Rosaceae

   Pollen grains of families Rosaceae, Solanaceae, and Leguminoseae are known for their long viability, lasting for months.

4. **(a)** Geitonogamy

   Transfer of pollen grains from anther to stigma of another flower of the same plant is known as Geitonogamy.

5. **(d)** (C), (B), (A), (D), (E)

   In angiosperms the correct sequence of events in formation of female gametophyte in the ovule is:

   Meiotic division in megaspore mother cell

   Degeneration of 3 megaspores

   3 successive free nuclear divisions in functional megaspore

   Migration of 3 nuclei toward each pole

   Formation of wall resulting in seven celled embryo sac.

6. **(c)** Bagging female flower buds in plants with unisexual flowers is necessary to prevent unwanted pollination from external pollen sources, ensuring controlled breeding and study. Bisexual flowers exhibiting protogyny can be used for controlled pollination if properly managed.

7. **(b)** The egg apparatus of an embryo sac in angiosperms typically consists of one egg cell, two synergids, three antipodal cells, and two polar nuclei.

8. **(b)** Autogamy is a type of self-pollination in which pollination is achieved within the same flower. In cleistogamous flowers, anther and stigma lie close to each other. In such flowers, when anthers dehisce in the flowers buds, pollen grains come in contact with stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous.
   A disadvantage of cleistogamy is absence of cross pollination due to which new varieties will not be formed.

9. **(a)** Bees, butterflies, flies, beetles, wasps, ants, moths, birds (sunbirds and humming birds) and bats are the common pollinating agents. Among the animals, insects, particularly bees are the dominant biotic pollinating agents.

10. **(d)** The mature embryo sac of an angiospermic plant is 8-nucleate and 7-celled. Three antipodals, one central cell, one egg cell and two synergids are formed, therefore the embryo sac is 7-celled and the central cell has two polar nuclei, therefore the embryo sac is eight nucleated.

11. **(d)** Xenogamy – Transfer of pollen grains from anther to the stigma of a different plant
    Geitonogamy – Transfer of pollen grains from the anther to the stigma of another flower of the same plant
    Chasmogamy – This condition is seen in flowers which are similar to other species whose anther and stigma are exposed.
    Cleistogamy – This is a condition in which flowers does not open.

12. **(c)** Pollen grains of few members of family Rosaceae, Leguminoseae and Solanaceae retain the viability of pollen grains for several months after their release.

13. **(c)** Pollen grain is haploid inside the diploid anther. Similarly, embryo sac is haploid inside the diploid ovule. Hence, pollen grain and embryo sac are the plant parts which consist of two generations one within the other.

14. **(d)** Water hyacinth and water lily are aquatic plants in which the flowers emerge above the level of water. They are pollinated by insects or wind as in most of the land plants.

15. **(d)** The attachment point of funicle and body of ovule is known as hilum.

16. **(a)** Wind pollination requires that the pollen grains are light and non-sticky so that they can be transported in wind currents. They often possess well-exposed stamens (so that the pollens are easily dispersed into wind currents) and large, often-feathery stigma to easily trap air-borne pollen grains. Wind-pollinated flowers often have a single ovule in each ovary and numerous flowers packed into an inflorescence.

17. **(d)** Sporopollenin is a major component of tough outer walls of pollen grains. It is chemically very stable and is usually well preserved in soils and sediments.

18. **(c)** Liquid nitrogen has an extraordinarily low boiling point of –196°C and thus used to preserve pollen grains.

19. **(c)** In angiosperms, one of the megaspores is functional while the other three degenerate. Only the functional megaspore develops into the female gametophyte (embryo sac).

20. **(b)** Autogamy is generally observed in monoecious plants. However, dioecious plants possess male and female organs in two different plants, and therefore, they prevent autogamy. On the other hand, geitonogamy, is also a type of self-pollination like autogamy. Dioecious plants possess their gametes in different plants and hence can prevent geitonogamy as well.

21. **(c)** Wind pollinated flowers often have a single ovule in each ovary and numerous flowers packed into an inflorescence.

22. **(b)** Pollination by insects (Entomophily), particularly bees is more common.

    Features of insect-pollinated flowers:

    - Large, colourful, fragrant and rich in nectar. Nectar & pollen grains are the floral rewards for pollination.
    - When the flowers are small, they form inflorescence to make them visible.
    - The flowers pollinated by flies and beetles secrete foul odours to attract these animals.
    - The pollen grains are generally sticky.

23. **(c)** Arising from the placenta are the megasporangia (Megasporangium), commonly called ovules.

24. **(d)** In a majority of aquatic plants such as water hyacinth and water lily, the flowers emerge above the level of water and are pollinated by insects or wind as in most of the land plants.

25. **(a)** In majority of angiosperms reduction division occurs in the megaspore mother cell. The process of formation of megaspores from the megaspore mother cell is called megasporogenesis. The MMC undergoes meiotic division. Meiosis results in the production of four megaspores.

26. **(a)** The pistil has the ability to recognise the pollen, whether it is of the right type (compatible) or of the wrong type (incompatible). If it is of the right type, the pistil accepts the pollen and promotes post-pollination events that lead to fertilisation. If the pollen is of the wrong type, the pistil rejects the pollen by preventing pollen germination on the stigma or the pollen tube growth in the style.

27. **(a)** The innermost wall layer is the tapetum. It nourishes the developing pollen grains. Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

28. **(d)** The proximal end of the filament is attached to the thalamus or the petal of the flower.

29. **(c)** Transfer of pollen grains from the anther to the stigma of another flower of the same plant. Although geitonogamy is functionally cross- pollination involving a pollinating agent, genetically it is similar to autogamy since the pollen grains come from the same.

30. **(d)** To aid pollination, to sustain animal visits, the flowers have to provide rewards to the animals. Nectar and pollen grains are the usual floral rewards.

31. **(b)** The process of formation of microspores and megaspores from a pollen mother cell (PMC) and megaspore mother cell (MMC), respectively through meiosis is known as microsporogenesis and megasporogenesis.

32. **(c)** Synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which plays an important role in guiding the pollen tube.

33. **(d)** Pollen grains represent the male gametophyte in angiosperms. When the pollen grain is mature it consists of two cells, the vegetative cell and generative cell. Generative cells later divided mitotically to give rise to two male gametes.

34. **(b)** The maxillary glands of a worker bee secrete "royal jelly"(honey) to feed young larvae. Pollen is meant for transfer by bees from one plant to another.

35. **(d)** Pollen grains are nutrient rich. It is used as food supplements.

36. **(a)** Filiform apparatus guides the growing pollen tube.

37. **(b)** Geitonogamy: Transfer of pollen grains from the anther to the stigma of another flower of same plant.

38. **(a)** Tapetum is the inner most layer which nourishes the developing embryo.

39. **(d)** There is no need of pollinators in closed flowers.

40. **(a)** Megasporangium is equivalent to ovule.

41. **(d)** Plants with ovaries having only one or a few ovules, are generally pollinated by wind. Wind pollination is common in grasses (E.g., Corn cob)

42. **(a)** Double fertilisation takes place in angiosperms at 2-celled stage.

43. **(c)** Pollen grain germinates on stigma to produce pollen tube through one of the germ pores.

44. **(b)** *Geitonogamy*: Transfer of pollen grains from the anther to the stigma of another flower of the same plant.

    Autogamy: In this type, pollination is achieved within the same flower.

    In dioecious plants like papaya and date palm both, autogamy and geitonogamy are prevented.

45. **(b)** Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

    Examples: *Viola* (common pansy), *Oxalis*, and *Commelina*

46. **(a)** A multicarpellary, apocarpous (free pistils) gynoecium is present in *Michelia*.

47. **(c)** The hard outer layer called the exine is made up of sporopollenin which is one of the most resistant organic materials known. It can withstand high temperatures and strong acids and alkali. No enzyme that degrades sporopollenin is so far known.

48. **(c)** In a majority of flowering plants, one of the megaspores is functional while the other three degenerate. Only the functional megaspore develops into the female gametophyte (embryo sac). This method of embryo sac formation from a single megaspore is termed monosporic development.

49. **(a)** Cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

50. **(d)** Wind pollination is common in grasses (e.g., *Zostera*).

51. **(d)** The synergids have special cellular thickenings at the micropylar tip called Filiform apparatus, which play important role in guiding the pollen tubes into the synergi

52. **(b)** Wind pollination requires that the pollen grains are sm light and non-sticky so that they can be transported in wi currents.

53. **(d)** Nucellus (2n), antipodal (n), Egg nucleus (n), second nucleus (n), MMC (2n).

54. **(a)** Exine of pollen grain is made up of sporopollenin whi is one of the most resistant organic materials known. It c withstand high temperatures and strong acids and alkali enzyme can degrades sporopollenin.

55. **(b)** Filiform apparatus present at the micropylar part of the synergids guides the entry of pollen tube.

56. (c) Unisexuality of flowers prevents autogamy but not geitonogamy. While dioecious plants prevents both autogamy and geitonogamy.

57. (d) The sporogenous tissue is surrounded by the tapetum layer which provides nourishment to the pollen or microspore mother cell. Callose is deposited on the wall of the pollen mother cell.

58. (d) Hemitropous (or Hemi - anatropous) ovule is the body of ovule which is placed transversely at right angles to the funicle. In this, micropyle & chalaza lie in one straight line, e.g., *Ranunculus*.

59. (b) Archesporium give rise to entire spore mother cells from which spores are derived. Archesporial cells undergo periclinal division to give a parietal layer that form pollen sac wall and a sporogeneous layer.

60. (b) Callose is a plant polysaccharide. It separates developing pollen grains in tetrad, preventing their underlying walls from fusing.

61. (b) In anatropous ovule, the microplyle faces the placenta when it is inverted. During development, anatropous ovule become completely inverted so that micropyle faces downward & lie close to the hilum.

62. (d) Coconut is believed to be largely cross-pollinated. It is essentially an anemophilous plant, i.e., pollen is distributed by wind.

63. (b) Grass is monocotyledonous. Primary sporogenous cell give rise to microspore mother cells (MMC). Each MMC undergo meiotic division and give rise to 4 pollens by process called microsporogenesis.

64. (d) In monosporic embryo sac, meiosis of diploid megaspore mother cell produces 4 haploid megaspores. In bisporic, meiosis produces 2 megaspores and in tetrasporic, single 4-nucleate megaspore is formed.

All three patterns give rise to a single functional megaspore that contains either one, two or four haploid nuclei.

65. (a) Ornithophily, also called bird pollination, is the pollination of flowering plants by birds. Birds are attracted by colourful flowers having nectars.

66. (a) In angiosperms, characters of flowers are used in classification because characters of angiospermic flowers are preserved for further studies and references.

67. (a) Pollen grains or microspores are formed inside anther, which is the fertile portion of stamen or microsporophyll. Inside the anther, primary sporogenous cell gives rise to microspore mother cells or pollen mother cells (MMC or PMC). Each MMC on reduction division gives rise to 4 microspores or pollens. So these four cells will give rise to $4 \times 4 = 16$ pollen grains.

68. (c) Each microspore mother cell produces 4 pollen grains by reductional division. Hence, 25 micropore mother cells would be require to produce 100 pollen grains.

69. (b) Geitonogamy is cross - pollination between the different flowers of same plant. It is the fertilisation of a female flower or female part of a flower by pollen from another flower on the same plant.

70. (b) Embryo sac in plants is female gametophyte, also termed megagametophyte, which produces egg cell for the purpose of fertilisation.

71. (d) Number of meiotic divisions required to produce 200 seeds of pea would be 250/500. 200 seeds of pea would be produced from 200 pollen grains and 200 eggs. 200 pollen grains will be formed by 50 microspore mother cell while 200 eggs will be formed by 200 megaspore mother cell = 250/200.

72. (a) Body of orthotropous ovule is straight so that chalaza and micropyle are aligned in a straight line.

73. (d) Nucellus, micropyle & embryo sac are part of female reproduction system of plants while pollen grain represents male part.

74. (b) There are seven haploid cells in the female gametophyte. They include three antipodal cells, one central cell, two synergid cells and one egg cell.

75. (c) Ovule is the structure that contains female reproductive cells. It consists of - outer layer of integuments, nucellus and embryo sac in its center.

76. (c) Pollination is the dispersal of pollen grains from stamen to stigma. It takes place in gymnosperms to land the pollen on female cones, and in angiosperms to land the pollen on stigma of flower.

77. (d) Vivipary is a characteristic of halophytes. Halophytes grow in saline conditions, and hence are adapted for viviparous germination. It is germination of seed inside the fruit while it is attached to plant.

78. (c) Filiform apparatus present at the micropylar part of the synergids guides the entry of pollen tube. Porogamy is the entrance of pollen tube in a seed plant through the micropyle. Chalazogamy is entrance through chalaza and mesogamy is the condition of entry of pollen tube through integuments.

79. (c) Female gametophyte, also called embryo sac, produces the central cell and the egg cell for double fertilization by two male nuclei.

80. (c) Microspores are land plant spores that give rise to male gametophyte and are usually smaller than megaspores that gives rise to female gametophyte.

81. (a) Gametes are always produced as haploid by meiotic division.

82. (c) For formation of 100 zygotes, 100 male gametes and 100 female gametes (eggs) are required. 100 male gametes are developed from 100 microspores (from 25 meiotic divisions) and 100 eggs are developed from 100 megaspores (from 100 meiotic division).

Hence, number of meiotic divisions necessary for 100 zygotes formation = 25 + 100 = 125.

83. (b) In angiosperms, pollen grains are released in 2-celled stage. The generative cell divides mitotically to give rise to 2 male gametes before pollen grains are shed (3-celled stage).

84. (d) Double fertilisation occurs when one of the two male gametes from pollen grain fertilises the egg and other male gamete fertilises the already fused two polar nuclei in central cell (i.e., triple fusion). First fertilisation of male gamete and egg is called syngamy.

85. (d) Synergids are part of egg apparatus that thought to help male nucleus reach the egg cell for fertilization.

86. (b) Double fertilisation is a complex fertilisation mechanism of flowering plants (angiosperms).

87. (a) One of the male gamete fuses centrally located two haploid polar nuclei to produce a triploid primary endosperm nucleus (PEN).

88. (d) In gymnosperms, endosperm is formed from haploid megaspore by repeated divisions and hence the ploidy of endosperm is haploid.

89. (b) If the female plant is tetraploid, then the central cell of embryo sac, which is a fused polar nuclei, will also be tetraploid. Fusion of the tetraploid central cell to the haploid male gamete forms a pentaploid endosperm in the given example.

90. (c) Fertilisation is a process to produce zygote that grow up in new individual. In angiosperms, one addition fertilization takes place between male nucleus & two polar nuclei in central cell to produce endosperm which surrounds and provides nutrition to growing embryo.

91. (a) Double fertilisation is a characteristic feature of flowering plants in which one male nucleus of pollen fertilises an egg cell while second fuses with two polar nuclei to produce a triploid primary endosperm nucleus.

92. (d) Two male gametes enter the megagametophyte through synergids. One of them fertilises the egg cell and other fuses with centrally located two polar nuclei or secondary nucleus. Thus, the process is called double fertilisation.

93. (d) Sperm & egg nuclei come closer by streaming current of cytoplasm, i.e., attraction in their protoplasts and eventually fuses together to form diploid zygote.

94. (a) Generative cell was destroyed by laser but a normal pollen tube was still formed because vegetative cell is not damaged.

95. (b) Sergei Navaschin discovered double fertilisation in plants in 1898. Leon Guignard was co-discoverer of double fertilisation in flowering plants, along with Navaschin.

96. (d) In angiosperms, the haploid diploid and triploid structure of a fertilised embryo sac sequentially are-

Synergids, Zygote and Primary endosperm nucleus

97. (d) In certain seeds like those of the beet and black pepper, the nucellus persists and contributes to the formation of the perisperm.

98. (d) In few species, fruits develop from the other parts of the flower such as thalamus. Such fruits are called false fruits. Examples include apple strawberry, cashew, etc.

99. (d) The fruits in which thalamus also contributes to fruit formation are called false fruits.

100. (d) Following are the post-fertilisation changes:

- Ovule → Seed
- Ovary → Fruit
- Zygote → Embryo
- Central cell → Endosperm

101. (b) The residual, persistent nucellus is called perisperm. *E.g.*: seeds of black pepper and beet

102. (d) In flowering plants, out of the two male gametes discharged in synergids, one fuses with the egg and other fuses with the secondary or definitive nucleus present in central cell.

Egg (n) + 1st male gamete (n) ⟶ Zygote (2n)

Secondary nucleus + 2nd male gamete (n) ⟶ PEN (3n)

(2n)

(central cell nuclei)

103. (a) The leaf primordia is enclosed in a hollow foliar structure called coleoptile (a protective sheath).

104. (d) In the grass family the cotyledon is called scutellum that is situated towards one side (lateral) of the embryonal axis.

105. (d) The coconut water from tender coconut that you are familiar with, is nothing but free-nuclear endosperm (made up of thousands of nuclei) and the surrounding white kernel is the cellular endosperm.

106. (c) The ovule is a small structure attached to the placenta by a stalk called funicle. The body of the ovule fuses with funicle in the region called hilum. This is persisted in seed also (seed is mature ovule).

107. (b) The monocot embryo has only one terminal, shield shape cotyledon called scutellum.

108. (c) In most of species, fruits are the results of fertilisation, but there are a few species in which fruits develops without fertilisation such fruits are called parthenocarpic fruits. *E.g.*, Banana.

109. (a) In the most common type of endosperm development, the primary endosperm nucleus (PEN) undergoes successive nuclear divisions to give rise to free nuclei. This stage is called free nuclear endosperm. The coconut water from tender coconut is free nuclear endosperm.

110. (a) Non Albuminous seed - Bean, Pea and Groundnut.

111. (d) Perisperm is diploid in nature and endosperm is triploid.

112. (b) The coconut water and the edible part of coconut are equivalent to endosperm.

113. (c) 3 antipodal + 2 polar nuclei + 3 (2 synergid + 1 egg)

114. (c) Pollen tube discharge its male gametes into degenerating synergids. These degenerated synergids give path for the entry of pollen tube within the chamber of embryo sac.

115. (d) Crossing between haploid male gametophyte of diploid plant & haploid pair of polar nuclei (each nucleus with one set of chromosome) result in triploid endosperm i.e.,

male gamete + 1st polar nucleus + 2nd polar nucleus → Endosperm
(n) (n) (n) (3n)

Tetraploid male will form diploid (2n) male gametophyte, hence, the ploidy of endosperm cells will be tetraploidy.

6. (d) Date fruit is composed of a pericarp, mesocarp, endocarp and one seed. Pericarp forms the skin which is edible along with mesocarp that forms pulp of the fruit.

117. (b) Embryology: Embryo + logy (to study), i.e., study of growing embryo from an egg.

Cytology is study of cells; embryogeny is formation and development of embryo which is actually studied in embryology; and apomixis is asexual reproduction in plants.

118. (b) In some seeds, a layer of nutritive tissue that is derived IAS nucellus surrounds the embryo and is called perisperm.

119. (c) Micropyle is a minute opening. The pollen tube usually enters through this pore in ovule of a seed plant but after fertilisation, micropyle helps in absorbing water at the time of seed germination.

120. (d) Apomixis involves seeds developing from unfertilized eggs, resulting in offspring identical to the parent plant. This allows farmers to consistently use these seeds for annual crop cultivation.

121. (d) Special mechanism to produce seeds without fertilisation called apomixis.

Apomixis occurs in some species of Asteraceae and grasses.

122. (b) Apomixis is the process of formation of seeds without fertilization. Thus, apomixis is a form of asexual reproduction that mimics sexual reproduction. Examples of Apomixis are some species of Asteraceae and grasses.

Hence in both vegetative reproduction and apomixes, progeny will identical to their parents.

123. (b) Nucellar polyembryony is reported in species of *Citrus*, Mango and *Opuntia*.

124. (a) Apomictic embryos in citrus arise from nucellus or integument (maternal sporophytic tissue in ovule).

125. (a) In adventitive embryony, embryo develops from nucellus or integument.

126. (a) In *Citrus*, many embryos are formed from the sporophytic tissue outside the embryo (nucellus). This kind of polyembryony is called adventive polyembryony.

127. (c) *Citrus* exhibits polyembryonic seed development in which many embryos arise from nucellus surrounding the developing zygotic embryo.

128. (d) Nucellus is central part of ovule containing embryo sac and it is diploid. These tissue, sometimes, may produce additional embryos by apomixis. Such nucellar embryos are clones of the parent & are diploid.

129. (d) Parthenogenesis is reproduction of a new individual from egg without fertilisation, common in invertebrates and lower plants.

130. (d) Parthenogenesis is a mode of asexual reproduction in which growth and development of embryo takes place without fertilisation.

131. (a) Apospory is development of diploid gametophyte without meiosis from diploid cells of the sporophytes.

132. (b) Apogamy occurs in some ferns, in which the sporophyte develops from the gametophyte without fusion of gametes.

CHAPTER 2

Human Reproduction

Male Reproductive System

1. Select the correct sequence for transport of sperm cells in male reproductive system. [MR*] *(2019)*
   a. Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal canal → Urethra
   b. Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus
   c. Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal canal → Urethra
   d. Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal canal → Urethra → Urethral meatus

2. Which of the following depicts the correct pathway of transport of sperms? *(2016 - II)*
   a. Rete testis → Vas deferens → Efferent ductules → Epididymis
   b. Efferent ductules → Rete testis → Vas deferens → Epididymis
   c. Rete testis → Efferent ductules → Epididymis → Vas deferens
   d. Rete testis → Epididymis → Efferent ductules → Vas deferens

3. The shared terminal duct of the reproductive and urinary system in the human male is: *(2015, 14)*
   a. Urethra b. Ureter
   c. Vas deferens d. Vasa efferentia

4. Sertoli cells occur in: *(2010 Pre, 1991)*
   a. Adrenal cortex and secrete adrenaline
   b. Seminiferous tubules and provide nutrition to germ cells
   c. Pancreas and secrete cholecystokinin
   d. Ovaries and secrete progesterone

5. Vasa efferentia lead from: *(2010 Pre)*
   a. Rete testis to vas deferens
   b. Vas deferens to epididymis
   c. Epididymis to urethra
   d. Testicular lobules to rete testis

6. Select the correct set of names for the parts A, B, C, D: *(2009)*

	A	B	C	D
a.	Ureter	Seminal vesicle	Prostate	Bulbourethral gland
b.	Ureter	Prostate	Seminal vesicle	Bulbourethral glands
c.	Vas deferens	Seminal vesicle	Prostate	Bulbourethral gland
d.	Vas deferens	Seminal vesicle	Cowper's gland	Prostate

7. Testosterone is produced by: *(1993)*
   a. Sertoli cells b. Leydig's cells
   c. Oxyntic cells d. Pituitary gland

8. Male hormone is produced in the testis by cells of: *(1993)*
   a. Sertoli b. Epithelial
   c. Spermatocytes d. Leydig

Female Reproductive System

9. Given below are two statements: [MR*] *(2023)*

Statement I: Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

Statement II: The cavity of the cervix is called cervical canal which along with vagina forms birth canal.

In the light of the above statements, choose the correct answer from the options given below:
   a. Statement I incorrect but Statement II is true.
   b. Both Statement I and Statement II are true.
   c. Both Statement I and Statement II are false.
   d. Statement I is correct but Statement II is false.

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10. Arrange the components of mammary gland (from proximal to distal). [MR*] *(2022 Re)*
(a) Mammary duct (b) Lactiferous duct
(c) Alveoli (d) Mammary ampulla
(e) Mammary tubules
Choose the most appropriate answer from the options given below.
a. (e) → (c) → (d) → (b) → (a)
b. (c) → (a) → (d) → (e) → (b)
c. (b) → (c) → (e) → (d) → (a)
d. (c) → (e) → (a) → (d) → (b)

11. Capacitation occurs in: *(2017-Delhi)*
a. Rete testis b. Epididymis
c. Vas deferens d. Female Reproductive tract

12. Capacitation refers to changes in the: *(2015)*
a. Ovum after fertilisation
b. Sperm after fertilisation
c. Sperm before fertilisation
d. Ovum before fertilisation

13. Part of fallopian tube closest to ovary is: *(2010 Pre)*
a. Infundibulum b. Cervix
c. Ampulla d. Isthmus

Gametogenesis

14. Arrange the sequence of different hormones for their role during gametogenesis. [MR*] *(2023-Manipur)*
A. Gonadotropin LH stimulates synthesis and secretion of Androgen
B. Gonadotropin releasing hormone from hypothalamus
C. Androgen stimulates spermatogenesis
D. Gonadotropin FSH helps in the process of spermiogenesis
E. Gonadotropins from anterior pituitary gland.
Choose the **correct** answer from the options given below:
a. (E), (A), (D), (B), (C) b. (C), (A), (D), (E), (B)
c. (B), (E), (A), (C), (D) d. (D), (B), (A), (C), (E)

Given below are two statements regarding oogenesis: [MR*] *(2023-Manipur)*
Statement I: The primary follicles get surrounded by more layers of granulosa cells, a theca and shows fluid filled cavity antrum. Now it is called secondary follicle.
Statement II: Graffian follicle ruptures to release the secondary oocyte from the ovary by the process called ovulation.
In the light of the above statements, choose the **correct** answer from the options given below:
a. **Statement I** is correct but **Statement II** is incorrect.
b. **Statement I** is incorrect but **Statement II** is correct.
c. Both **Statement I** and **Statement II** are correct.
d. Both **Statement I** and **Statement II** are incorrect.

16. How many secondary spermatocytes are required to form 400 million spermatozoa? *(2022 Re)*
a. 400 million b. 50 million
c. 100 million d. 200 million

17. Which of the following statements are true for spermatogenesis but do not hold true for Oogensis? [MR*] *(2022)*
A. It results in the formation of haploid gametes
B. Differentiation of gamete occurs after the completion of meiosis
C. Meiosis occurs continuously in a mitotically dividing stem cell population
D. It is controlled by the Luteinising hormone (LH) and Follicle Stimulating Hormone (FSH) secreted by the anterior pituitary
E. It is initiated at puberty
Choose the most appropriate answer from the options given below.
a. B, C and E only b. C and E only
c. B and C only d. B, D and E only

18. At which stage of life the oogenesis process is initiated? *(2021)*
a. Adult
b. Puberty
c. Embryonic development stage
d. Birth

19. Given below are two statements: *(2021)*
Statement I: The release of sperms into the seminiferous tubules is called spermiation
Statement II: Spermiogenesis is the process of formation of sperms from spermatogonia
In the light of the above statements, choose the most appropriate answer from the options given below.
a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both statement I and statement II are incorrect
d. Statement I is correct but Statement II is incorrect

20. Meiotic division of the secondary oocyte is completed: *(2020)*
a. At the time of copulation
b. After zygote formation
c. At the time of fusion of a sperm with an ovum
d. Prior to ovulation

21. Select the correct option of haploid cells from the following groups: [MR*] *(2020-Covid)*
a. Secondary spermatocyte, First polar body, Ovum
b. Spermatogonia, Primary spermatocyte, Spermatid
c. Primary spermatocyte, Secondary spermatocyte, Second polar body
d. Primary oocyte, Secondary oocyte, Spermatid

22. Extrusion of second polar body from egg nucleus occurs: *(2019)*
a. After entry of sperm but before fertilisation
b. After fertilisation
c. Before entry of sperm into ovum
d. Simultaneously with first cleavage

23. The difference between spermiogenesis and spermiation is: [MR*] *(2018)*
a. In spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed.
b. In spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed.
c. In spermiogenesis spermatozoa from Sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed.
d. In spermiogenesis spermatozoa are formed, while in spermiation spermatozoa are released from Sertoli cells into the cavity of seminiferous tubules.

24. Which of the following cells during gametogenesis is normally diploid? *(2015)*
a. Spermatogonia b. Secondary polar body
c. Primary polar body d. Spermatid

25. What is the correct sequence of sperm formation? *(2013)*
a. Spermatogonia, Spermatocyte, Spermatid, Spermatozoa
b. Spermatid, Spermatocyte, Spermatogonia, Spermatozoa
c. Spermatogonia, Spermatocyte, Spermatozoa, Spermatid
d. Spermatogonia, Spermatozoa, Spermatocyte, Spermatid

26. Which one of the following statements is false in respect of viability of mammalian sperm? *(2012 Pre)*
a. Sperms must be concentrated in a thick suspension
b. Sperm is viable for only up to 24 hours
c. Survival of sperm depends on the pH of the medium and is more active in alkaline medium
d. Viability of sperm is determined by its motility

27. Which is correct about human sperm? *(2010 Pre)*
a. Sperm lysins in acrosome dissolve egg envelope facilitating fertilisation
b. Acrosome serves as sensory structure leading sperm towards ovum
c. Acrosome has no particular function
d. Acrosome has conical tip for piercing and penetrating egg for fertilisation

28. Second maturation division of mammalian ovum occurs: *(2010 Pre)*
a. Until after sperm has penetrated ovum
b. Until nuclei of sperm and ovum fuse
c. In Graafian follicle soon after first maturation division
d. Shortly after ovulation before entry into fallopian tube

29. Secretions from which one of the following is rich in fructose, calcium and some enzymes? *(2010 Mains)*
a. Male accessory glands b. Pancreas
c. Liver d. Salivary glands

30. Seminal plasma of humans is rich in: *(2009, 2010 Pre)*
a. Fructose and certain enzymes, poor in Ca^{2+}
b. Fructose, Ca^{2+} and certain enzymes
c. Fructose, Ca^{2+} but no enzymes
d. Glucose, certain enzymes but no Ca^{2+}

31. Fertilizin is a chemical substance produced from: *(1997)*
a. Polar bodies b. Middle piece of sperm
c. Mature eggs d. Acrosome

32. Extrusion of second polar body from egg nucleus occurs: *(1993)*
a. After entry of sperm before completion of fertilisation
b. After completion of fertilisation
c. Before entry of sperm
d. Without any relation of sperm entry

33. Acrosome reaction in sperm is triggered by: *(1993)*
a. Capacitation b. Release of lysin
c. Influx of Na^+ d. Release of fertilizin

34. Middle piece of mammalian sperm possesses: *(1991)*
a. Mitochondria and centriole
b. Mitochondria only
c. Centriole only
d. Nucleus and mitochondria

35. How many sperms are formed from a secondary spermatocyte? *(1990)*
a. 4 b. 8
c. 2 d. 1

36. Egg is liberated from ovary in: *(1989)*
a. Secondary oocyte stage b. Primary oocyte stage
c. Oogonial stage d. Mature ovum stage

Menstrual Cycle

37. Which of the following statements are correct regarding female reproductive cycle? [MR*] (2023)
A. In non-primate mammals cyclical changes during reproduction are called oestrus cycle.
B. First menstrual cycle begins at puberty and is called menopause.
C. Lack of menstruation may be indicative of pregnancy.
D. Cyclic menstruation extends between menarche and menopause.
Choose the most appropriate answer from the options given below:
a. A, C and D only b. A and D only
c. A and B only d. A, B and C only

38. Which of the following hormone levels will cause release of ovum (ovulation) from the graafian follicle? [MR*] *(2020)*
a. High concentration of Progesterone
b. Low concentration of LH
c. Low concentration of FSH
d. High concentration of Estrogen

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39. A temporary endocrine gland in the human body is: *(2017-Delhi)*
a. Pineal gland b. Corpus cardiacum
c. Corpus luteum d. Corpus allatum

40. Changes in GnRH pulse frequency in females is controlled by circulating levels of: *(2018 - I)*
a. Estrogen and progesterone
b. Estrogen and inhibin
c. Progesterone only
d. Progesterone and inhibin

41. Which of the following events is not associated with ovulation in human female? *(2015 Re)*
a. Full development of Graafian follicle
b. Release of secondary oocyte
c. LH surge
d. Decrease in estradiol

42. Menstrual flow occurs due to lack of: *(2015)*
a. Vasopressin b. Progesterone
c. FSH d. Oxytocin

43. The secretory phase in the human menstrual cycle is also called: *(2012 Mains)*
a. Luteal phase and lasts for about 6 days
b. Follicular phase lasting for about 6 days
c. Luteal phase and lasts for about 13 days
d. Follicular phase and lasts for about 13 days

44. About which day in a normal human menstrual cycle does rapid secretion of LH (Popularly called LH-surge) normally occurs? *(2013 Mains)*
a. 5th day b. 11th day
c. 14th day d. 20th day

45. In a regularly cycling human female, which one is not cause of menstrual failure? *(2009)*
a. Fertilization of ovum
b. Maintenance of hypertrophied endometrial lining
c. Maintenance of high titre of sex hormones
d. Retention of well developed corpus luteum

46. Which is correctly matched? [MR*] *(2009)*
a. Menstruation- Breakdown of myometrium and ovum not fertilised
b. Ovulation- LH and FSH attain peak level, sharp fall in secretion of progesterone
c. Development of Corpus luteum- Secretory phase and increased secretion of progesterone
d. Proliferative Phase- Rapid regeneration of myometrium and maturation of Graafian follicle

47. Which is incorrect about menstruation? *(2008)*
a. At menopause, there is abrupt increase in gonadotropic hormones
b. Beginning of cycle of menstruation is called menarche
c. During normal menstruation about 40 mL of blood is lost
d. Menstrual fluid can easily clot

48. In human females, menstruation can be delayed by administration of
a. FSH and LH b. Estrogen and progesterone
c. FSH only d. LH only

49. Which one functions as endocrine gland also?
a. Sertoli b. Vitelline membrane
c. Germinal epithelium d. Graafian follicle

50. Withdrawal of which hormone is the immediate cause of menstruation?
a. Estrogen b. FSH
c. FSH-LH d. Progesterone

51. If mammalian ovum fails to fertilised, which of the following is unlikely?
a. Corpus luteum will disintegrate
b. Primary follicle starts developing
c. Progesterone secretion rapidly declines
d. Estrogen secretion further decreases

52. Ovulation in the human female normally takes place during the menstrual cycle:
a. Just before the end of the secretory phase
b. At the beginning of the proliferative phase
c. At the end of the proliferative phase
d. At the mid secretory phase

53. Mainly which hormones control menstrual cycle in human beings?
a. FSH b. LH
c. FSH, LH, Estrogen d. Progesterone

54. Which set is similar?
a. Corpus luteum - Graafian follicles
b. Sebum - Sweat
c. Bundle of His - Pace maker
d. Vitamin B_2 - Niacin

55. After ovulation, follicles converted into:
a. Corpus luteum b. Corpus albicans
c. Corpus cavernosa d. Corpus callosum

56. In the fertile human female, approximately on which day of the menstrual cycle does ovulation take place?
a. Day 14 b. Day 18
c. Day 1 d. Day 8

57. The mammalian corpus luteum produces:
a. Luteotrophic hormone b. Luteinising hormone
c. Estrogen d. Progesterone

58. In the 28 day human ovarian cycle, the ovulation takes place typically on:
a. Day 14 of the cycle b. Day 28 of the cycle
c. Day 1 of the cycle d. Day 5 of the cycle

59. The immediate cause of initiation of ovulation in human female is the large pulse surge of:
a. LH b. FSH *(1994)*
c. Progesterone d. Estradiol

Fertilisation and Implantation & Pregnancy and Embryonic Development

60. Given below are two statements one is labelled as Assertion A and the other is labelled as Reason R. [MR*] *(2023)*
Assertion A: Endometrium is necessary for implantation of blastocyst.
Reason R: In the absence of fertilization, the corpus luteum degenerates that causes disintegration of endometrium.
In the light of the above statements, choose the correct answer from the options given below:
a. A is false but R is true.
b. Both A and R are true and R is the correct explanation of A.
c. Both A and R are true but R is NOT the correct explanation of A.
d. A is true but R is false.

61. Receptors for sperm binding in mammals are present on: *(2021)*
a. Vitelline membrane b. Perivitelline space
c. Zona pellucida d. Corona radiata

62. Which of the following secretes the hormone, relaxin during the later phase of pregnancy? *(2021)*
a. Corpus luteum b. Fetus
c. Uterus d. Graafian follicle

63. In human beings, at the end of 12 weeks (first trimester) of pregnancy, the following is observed: *(2020-Covid)*
a. Most of the major organ systems are formed
b. The head is covered with fine hair
c. Movement of the foetus
d. Eyelids and eyelashes are formed

64. Hormones secreted by the placenta to maintain pregnancy are: *(2019)*
a. hCG, hPL, progestogens, prolactin
b. hCG, hPL, estrogens, relaxin, oxytocin
c. hCG, hPL, progestogens, estrogens
d. hCG, progestogens, estrogens, glucocorticoids

65. The zygote of mammalian embryo is derived from: *(2019)*
a. Ectoderm and mesoderm
b. Endoderm and mesoderm
c. Mesoderm and trophoblast
d. Ectoderm and endoderm

66. Several hormones like hCG, hPL, estrogen, progesterone are produced by: *(2018 - II)*
a. Fallopian tube b. Pituitary
c. Ovary d. Placenta

67. Identify the correct statement on relaxin: *(2018 - II)*
a. Initiates the secretion of LH, FSH and Prolactin
b. Is produced by granulosa cells in ovary and enables the secretion of FSH
c. Is produced by granulosa cells in ovary and enables the secretion of LH
d. Is produced by corpus cells in testes and enables the secretion of LH

68. Fertilization in humans is practically feasible only if: [MR*] *(2018 - I)*
a. The sperms are transported into vagina just after the release of ovum in fallopian tube
b. The ovum and sperms are transported simultaneously to ampullary - isthmus junction of the fallopian tube
c. The ovum and sperms are transported simultaneously to ampullary - isthmus junction of the cervix
d. The sperms are transported into cervix within 48 hrs of release of ovum in uterus

69. In human females, meiosis-II is not completed until: *(2015 Re)*
a. Fertilization b. Uterine implantation
c. Birth d. Puberty

70. Which of the following layers in an ovarian follicle is acellular? *(2015 Re)*
a. Theca interna b. Stroma
c. Zona pellucida d. Granulosa

71. Select the correct option describing gonadotropin activity in a normal pregnant female: *(2014)*
a. High level of hCG stimulates the thickening of endometrium
b. High level of FSH and LH stimulates the thickening of endometrium
c. High level of FSH and LH facilitate implantation of the embryo
d. High level of hCG stimulates the synthesis of estrogen and progesterone

72. In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was: *(2012 Pre)*
a. High level of circulating HCG to stimulate estrogen and progesterone synthesis
b. High level of circulating FSH and LH in the uterus to stimulate implantation of the embryo
c. High level of circulating HCG to stimulate endometrial thickening
d. High levels of FSH and LH in uterus to stimulate endometrial thickening

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73. Identify the human development stage shown below as well as the related right place of its occurrence in a normal pregnant woman, and select the right option for the two together: [MR*] *(2012 Mains)*

	Developmental stage	Site of occurrence
a.	Late morula	Middle part of Fallopian tube
b.	Blastula	End part of Fallopian tube
c.	Blastocyst	Uterine wall
d.	8 - celled morula	Starting point of Fallopian tube

74. Foetal movement and appearance of hair on head occur in_____ month of pregnancy: *(2010 Pre)*
a. Fifth b. Sixth
c. Third d. Fourth

75. Which is correct about morula? *(2010 Mains)*
a. Less cytoplasm and less DNA than zygote
b. Same amount of cytoplasm and DNA as zygote
c. More cytoplasm and more DNA than zygote
d. Same amount of cytoplasm but much more DNA than zygote

76. In human females, the blastocyst: *(2010 Mains)*
a. Gets implanted in endometrium by trophoblast cells
b. Forms placenta even before implantation
c. Gets implanted into uterus 3 days after ovulation
d. Gets nutrition from uterine endometrial secretion only after implantation

77. Which extra embryonic membrane in human prevents desiccation of embryo inside uterus? *(2008)*
a. Yolk sac b. Amnion
c. Chorion d. Allantois

78. Grey crescent is the area: *(2005)*
a. At the point of entry of sperm into ovum
b. At the animal pole
c. Just opposite the site of entry of sperm
d. At the vegetal pole

79. Which of the following hormones is not a secretion product of human placenta? *(2004)*
a. Prolactin
b. Estrogen
c. Progesterone
d. Human chorionic gonadotropin

80. What is true for cleavage? *(2004)*
a. Size of embryo increase b. Size of cells decrease
c. Size of cells increase d. Size of embryo decrease

81. Cleavage in mammals: *(2004)*
a. Holoblastic equal b. Holoblastic unequal
c. Superficial d. Discoidal

82. Correct sequence of embryo development: *(1996)*
a. Gamete → Zygote → Morula → Blastula → Gastrula
b. Gamete → Zygote → Blastula → Morula → Gastrula
c. Gamete → Neurula → Gastrula
d. Gastrula → Neurula → Morula

83. In an egg, the type of cleavage is determined by: *(1995)*
a. The amount and distribution of yolk
b. The number of egg membranes
c. The shape and size of the sperm
d. The size and location of the nucleus

84. What is true about cleavage in the fertilised egg in humans? *(1994)*
a. It starts while the egg is in fallopian tube
b. It starts when the egg reaches uterus
c. It is meroblastic
d. It is identical to the normal mitosis

85. The extra embryonic membranes of the mammalian embryo are derived from: *(1994)*
a. Trophoblast b. Inner cell mass
c. Formative cells d. Follicle cells

86. Termination of gastrulation is indicated by: *(1993)*
a. Obliteration of blastocoel
b. Obliteration of archenteron
c. Closure of blastopore
d. Closure of neural tube

87. Meroblastic cleavage is a division which is: *(1992)*
a. Horizontal b. Partial/parietal
c. Total d. Spiral

88. Eye lens is formed from: *(1992)*
a. Ectoderm b. Mesoderm
c. Endoderm d. Ectoderm and mesoderm

89. Blastopore is: *(1992)*
a. Opening of neural tube
b. Opening of gastrocoel
c. Future anterior end of embryo
d. Found in blastula

90. During cleavage, what is true about cells? *(1991)*
a. Nucleocytoplasmic ratio remains unchanged
b. Size does not increase
c. There is less consumption of oxygen
d. The division is like meiosis

91. Freshly released human egg has: *(1991)*
a. One Y-chromosome
b. One X-chromosome
c. Two X-chromosome
d. One X-chromosome and one Y-chromosome

92. Gonads develop from embryonic: *(1990)*
a. Ectoderm
b. Endoderm
c. Mesoderm
d. Both mesoderm and endoderm

93. Cells become variable in morphology and function in different regions of embryo. The process is: *(1989)*
a. Differentiation b. Metamorphosis
c. Organisation d. Rearrangement

Parturition and Lactation

94. Which of these is not an important component of initiation of parturition in humans? [MR*] *(2021)*
a. Synthesis of prostaglandins
b. Release of Oxytocin
c. Release of Prolactin
d. Increase in estrogen and progesterone ratio

95. Which of these is not an important component of initiation of parturition in humans? *(2015)*
a. Release of oxytocin
b. Release of prolactin
c. Increase in estrogen and progesterone ratio
d. Synthesis of prostaglandins

96. Signals for parturition originate from: *(2012 Pre)*
a. Fully developed foetus only
b. Both placenta as well as fully developed foetus
c. Oxytocin released from maternal pituitary
d. Placenta only

97. Signals from the fully developed fetus and placenta ultimately lead to parturition which requires the release of: *(2010 Mains)*
a. Estrogen from placenta
b. Oxytocin from foetal pituitary
c. Oxytocin from maternal pituitary
d. Relaxin from placenta

98. Foetal ejection reflex in human female is induced by: *(2010 Pre, 2009)*
a. Release of oxytocin from pituitary
b. Pressure exerted by amniotic fluid
c. Differentiation of mammary glands
d. Fully developed foetus and placenta

99. In human adult females, oxytocin: *(2008)*
a. Stimulates pituitary to secrete vasopressin
b. Causes strong uterine contractions during parturitions
c. Is secreted by anterior pituitary
d. Stimulates growth of mammary glands

Answer Key

1. (b)	2. (c)	3. (a)	4. (b)	5. (a)	6. (c)	7. (b)	8. (d)	9. (b)	10. (d)
11. (d)	12. (c)	13. (a)	14. (c)	15. (b)	16. (d)	17. (a)	18. (c)	19. (c)	20. (c)
21. (a)	22. (a)	23. (d)	24. (a)	25. (a)	26. (b)	27. (a)	28. (a)	29. (a)	30. (b)
31. (c)	32. (a)	33. (c)	34. (a)	35. (c)	36. (a)	37. (a)	38. (d)	39. (c)	40. (a)
41. (d)	42. (b)	43. (c)	44. (c)	45. (a)	46. (c)	47. (d)	48. (b)	49. (d)	50. (d)
51. (d)	52. (c)	53. (c)	54. (a)	55. (a)	56. (a)	57. (d)	58. (a)	59. (a)	60. (c)
61. (c)	62. (a)	63. (a)	64. (c)	65. (a)	66. (d)	67. (b)	68. (b)	69. (a)	70. (c)
71. (d)	72. (a)	73. (c)	74. (a)	75. (d)	76. (a)	77. (b)	78. (c)	79. (a)	80. (b)
81. (a)	82. (a)	83. (a)	84. (a)	85. (a)	86. (a)	87. (b)	88. (a)	89. (b)	90. (b)
91. (b)	92. (c)	93. (a)	94. (c)	95. (b)	96. (b)	97. (c)	98. (d)	99. (b)	

Explanations

1. **(b)** The correct sequence for transport of sperm cells in male reproductive system is Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus

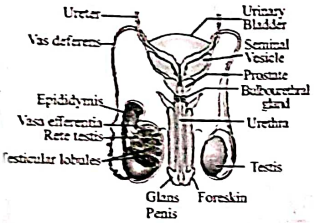
2. **(c)** Seminiferous tubules unite to form straight tubules → open into rete testis (irregular cavities) → Vasa efferentia (series of fine tubules that conduct sperms) → epididymis (stores sperms temporarily) → vas deferens → join with a duct from seminal vesicle to form common ejaculatory duct → opens into urethra → urethral meatus (external opening).

3. **(a)** Urethra is the urinary duct which originates from the neck of urinary bladder and opens to the exterior at the tip of penis in males. It is a common pathway for passage of urine and semen.

4. **(b)** Sertoli cells present in seminiferous tubules and provide nutrition to germ cells.

5. **(a)** Seminiferous tubules → rete testis → Vasa efferentia → epididymis → Vas deferens

6. **(c)**



7. **(b)** Leydig cells are present in interstitial space of testis. These cells produce a group of male hormones called androgens mainly testosterone.

8. **(d)** Leydig cells or interstitial cells synthesise and secrete testicular hormones called androgens. Sertoli cells provide nourishment to growing spermatocytes.

9. **(b)** Each ejaculatory duct is formed by the union of the duct from the seminal vesicle and the vas deferens. They opens into the prostatic urethra.

   Cervical canal (interior of the cervix) along with vagina forms the birth canal.

10. **(d)** (c) → (e) → (a) → (d) → (b)

    The components of mammary gland from proximal to distal :

    Alveoli → mammary tubules→ mammary duct→ mammary ampulla→ lactiferous duct.

11. **(d)** Capacitation is increase in fertilising capacity of sperms which occurs in female reproductive tract.

12. **(c)** Capacitation is the preparation of sperm to fertilise the ovum. It is the final stage in the maturation process of spermatozoan. It takes place inside the genital tract as the sperm penetrates the ovum.

13. **(a)** The oviducts (fallopian tubes), uterus and upper part of vagina constitute the female accessory ducts. Each fallopian tube is about 10-12 cm long and extends from the periphery of the ovary to the uterus, the part closer to the ovary is the funnel shaped infundibulum.

14. **(c)** (B), (E), (A), (C), (D)

    The correct sequence for hormone roles during gametogenesis starts with the release of Gonadotropin-releasing hormone (GnRH) from the hypothalamus, stimulating the anterior pituitary gland to secrete gonadotropins (LH and FSH). LH stimulates the synthesis and secretion of androgens which in turn stimulate spermatogenesis. FSH assists in spermiogenesis.

15. **(b)** Statement I is incorrect but Statement II is correct.

    Tertiary follicle or Graafian follicle is characterised by a fluid-filled cavity, called antrum, not a secondary follicle. Graafian follicle ruptures to release the secondary oocyte from the ovary during ovulation.

16. **(d)** During spermatogenesis, a secondary spermatocyte gives rise to two spermatids, which then develop into spermatozoa. Thus, to form 400 million spermatozoa, 200 million secondary spermatocytes are required.

17. **(a)** Gametogenesis is the process by which diploid precursor cells undergo meiotic division to become haploid gametes. In males, this process is called spermatogenesis and produces spermatozoa (sperm). In females, this process is called oogenesis and produce ova (eggs).

    In spermatogenesis, the spermatids undertake a process of differentiation in order to become functional sperm cells (spermatozoa).

    Spermatogenesis is initiated at the time of puberty while oogenesis is initiated at the time of embryonic development.

    In case of spermatogenesis, all the stages of meiosis take place quickly after one another and there is no time lag between them. In the case of oogenesis, meiosis is suspended at the Prophase I state. Meiosis resumes only once the puberty begins.

18. **(c)** Oogenesis is defined as the process of formation of functional haploid ova from the diploid germinal cells in the ovary. The process is initiated during embryonic development.

19. **(c)** The process of transformation of spermatids into spermatozoa (sperms) is called spermiogenesis.

    After spermiogenesis, the release of sperms from the seminiferous tubules is called spermiation.

20. **(c)** Meiotic division of secondary oocyte is completed after the entry of sperm in secondary oocyte which lead to the formation of a large ovum and a tiny second polar body.

21. **(a)** Spermatogonia, primary spermatocyte and primary oocyte are diploid cells.

22. **(a)** Extrusion of second polar body from egg nucleus occurs after entry of sperm but before fertilisation.

    The entry of sperm into the ovum induces completion of the meiotic division of the secondary oocyte.

    Entry of sperm causes breakdown of metaphase promoting factor (MPF) and turns on anaphase promoting complex (APC).

23. **(d)** Spermatogenesis – formation of spermatids.

    Spermiogenesis – formation of spermatozoa from spermatids.

    Spermiation – Release of spermatozoa into seminiferous tubule's cavity.

24. **(a)** Spermatogonia (2n)

    Secondary polar body (n)

    Primary polar body (n)

    Spermatid (n)

25. **(a)** The spermatogonia present on the inside wall of seminiferous tubules multiply by mitotic division and increase in number. Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. After completing first meiotic division, two equal, haploid cells called secondary spermatocytes are formed which undergo the second meiotic division to produce four equal, haploid spermatids. The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis.

26. **(b)** The viability of the sperm is of several days.

27. **(a)** Sperm lysins are meant to dissolve egg envelope facilitating fertilisation.

28. **(a)** Entrance of sperm nucleus activates the ovum nucleus to complete IInd meiosis through suppression of MPF (metaphase promoting factor) and activation of APF and after completion of meiosis-II.

29. **(a)** Secretions of bulbourethral, prostate gland and seminal vesicles constitute the seminal plasma which is rich in fructose, calcium and certain enzymes.

30. **(b)** Secretions of bulbourethral, prostate gland and seminal vesicles constitute the seminal plasma which is rich in fructose, calcium and certain enzymes.

31. **(c)** Egg (ovum) secretes a chemical named fertilizin (composed of glycoprotein + monosaccharides + amino acids). Sperm has on its surface a protein substance called antifertilizin (composed of acidic amino acids). The fertilizin of an egg interacts with the antifertilizin of a sperm of the same species. This interaction makes the sperms stick to the egg surface. The adhesion of sperm to the egg of the same species through chemical recognition is known as agglutination.

32. **(a)** The entry of sperm stimulates the secondary oocyte to resume and complete the suspended meiosis II. This produces a haploid mature ovum and a second polar body. The second polar body immediately degenerates and sperm tail as well.

33. **(c)** Acrosome reaction is calcium-dependent involving massive uptake of calcium and sodium within an efflux of hydrogen generating high pH and osmotic pressure.

34. **(a)** Middle piece of sperm has a central filamentous core with many ATP producing mitochondria spiralled around it. Just below the head, midpiece contains centriole of sperm.

35. **(c)** A secondary spermatocyte undergo second meiotic division to form two spermatids which differentiates into two spermatozoa.

36. **(a)** In humans, egg is released from the ovary in the secondary oocyte stage by rupturing the graafian follicles. It is called ovulation.

37. **(a)** All options are correct except option B. First menstrual cycle begins at puberty is called menarche, not menopause.

38. **(d)** Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).

39. **(c)** After ovulation, Graafian follicle is transformed into a yellow endocrine mass called Corpus luteum. It secretes progesterone.

40. **(a)** Changes in GnRH pulse frequency in females is controlled by circulating levels of estrogen and progesterone.

41. **(d)** During ovulation, Graafian follicle becomes fully developed. There is a release of secondary oocyte on the 14th day of cycle. Level of LH becomes maximum during mid cycle called LH surge. There is increase in estradiol.

42. **(b)** Progesterone maintains endometrium for pregnancy.

43. **(c)** In a menstrual cycle, luteal phase (13-14 days) is called secretory phase.

44. **(c)** About 14th day in a normal human menstrual cycle, rapid secretion of LH (Popularly called LH-surge) normally occurs.

45. **(a)** Failure of menstruation is the indication of pregnancy.

46. **(c)** Menstruation- breakdown of endometrial lining.

    Ovulation- LH and FSH attains peak level, there is moderate level of progesterone

    Corpus luteum- Secretory phase, maintains progesterone level

    Proliferative phase – Regeneration of endometrium

47. **(d)** Menstrual fluid is normally non-clotting because a fibrinolysin is released along with necrotic endometrial material.

48. **(b)** Combination of estrogen and progesterone stops in blood this leads to onset of menstruation, therefore by supply of estrogen and progesterone can be deferred.

49. **(d)** Remnants of mature Graafian follicles after ovulation are transformed into corpus luteum. Corpus luteum begins to secrete hormone progesterone; estrogen and inhibin hence act as endocrine gland.

50. **(d)** Corpus luteum is the site of synthesis of progesterone. Progesterone meant to maintain endometrium for implantation of fertilised egg. Decline of progesterone level is the immediate cause of menstruation.

51. **(d)** If human ovum is failed to fertilise, as a result corpus luteum degenerates, progesterone level declines rapidly since corpus luteum secretes progesterone. Estrogen level also decrease. Endometrial lining breaks followed by bleeding.

52. (c) Luteinising hormone is rapidly secreted during proliferative phase of menstrual cycle. At the end of this phase or during mid-cycle, it attains a peak level which induces the rupture of Graafian follicle and thus ovum is released out of follicle, process called ovulation.

53. (c) LH & FSH (gonadotropins) stimulates the follicular development and these growing follicles secrete estrogen, which altogether maintains the menstrual cycle in females.

54. (a) Corpus luteum is a degenerated Graafian follicle.

55. (a) After ovulation (release of ovum), Graafian follicle starts to degenerate and form yellowish corpus luteum.

56. (a) In middle of the menstrual cycle, i.e., 14th day, level of gonadotropins attain a maximum level and causes release of ovum or ovulation.

57. (d) Corpus luteum is a transformed Graafian follicle, after ovulation, that secretes hormone progesterone.

58. (a) Ovulation is the releasing of egg by ruptured Graafian follicle. The wall of Graafian follicle is ruptured by sudden increase in the level of luteinising hormone. The length of menstruation cycle is 28 days (average) from the start of one menstruation period to the start of the next. At about 14th day of the cycle, the distended follicle ruptures and the ovum is extruded into the fallopian tube.

59. (a) LH (luteinising hormone) is released by anterior lobe of pituitary gland. It causes ovulation, secretion of estrogen from mature ovarian follicle and progesterone from corpus luteum.

60. (c) Both assertion and reason are correct but reason is not correct explanation why endometrium is necessary for implantation of blastocyst. The attachment of a blastocyst to the endometrium is called the implantation. It occurs about 6 days after fertilisation. The endometrium is necessary for implantation as it serves as a key place not only for supporting foetal growth through supplementation of oxygen and nutrients but also for protecting the embryo and later the foetus from microbial invasion during pregnancy.

If fertilisation does not occur, the levels of progesterone and estrogens decline due to degeneration of the corpus luteum. Withdrawal of progesterone and estrogens causes disintegration of the endometrium leading to menstruation.

61. (c) Receptors for sperm binding in mammals are present on zona pellucida.

The corona radiata is the innermost layer and is directly adjacent to the zona pellucida.

The perivitelline space is the space between the zona pellucida and the cell membrane of an oocyte or fertilized ovum.

Vitelline membrane surrounds the outer surface of the plasma membrane of an ovum.

62. (a) The hormone relaxin is produced by the corpus luteum of ovary in the later phase of pregnancy.

Uterus and foetus do not secrete the relaxin hormone.

Graafian follicle is not formed during pregnancy.

63. (a) By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed.

64. (c) Placenta is an endocrine gland present during pregnancy. It secretes human chorionic gonadotropin (hCG), progesterone, estrogen and human placental lactogen (hPL).

65. (a) Chorion and amnion are derived from the trophoblast, ectoderm and extraembryonic somatic mesoderm, i.e., somatopleure. Yolk sac and allantois are splanchnopleuric, i.e., derived from endoderm and extraembryonic splanchnic mesoderm.

66. (d) Placenta also acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc.

67. (b) Inhibin is produced by granulosa cells in ovary and inhibits the secretion of FSH.

68. (b) Fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampullary isthmic junction. This is the reason why not all copulations lead to fertilisation and pregnancy.

69. (a) In human, the first polar body does not undergo meiosis II, whereas secondary oocyte proceeds as far as the metaphase stage of meiosis II. However, it then stops advancing any further it awaits the arrival of sperm for completion of meiosis II.

70. (c) Zona pellucida is the thick non - cellular membrane that develops around the oocyte within the ovarian follicle. It is penetrated by atleast one spermatozoan at fertilisation and persists around the blastocyst until it reaches the uterus.

71. (d) hCG is secreted by endocrine placenta in phase of pregnancy. It maintains the lining of endometrium by synthesis of estrogen & progesterone after implantation.

72. (a) In a pregnant female, high levels of hCG will maintain corpus luteum and stimulate it to secrete estrogen and progesterone.

73. (c) The morula (18 to 16 blastomeres) continues to divide and transforms into blastocyst as it moves further into the uterus.

74. (a) The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month.

75. (d) Morula has same amount of cytoplasm but much DNA than zygote.

76. (a) The placenta forms the trophoblast and the endometrium roughly 5 weeks after implantation. The blastocyst get implanted in the uterus about 5-7 days after fertilisation. The implantation is via the trophoblast layer of the blastocyst that adheres to the uterine endometrium. The embryo receives oxygen and nutrition from the mother through this adhesion after implantation in the uterus.

77. (b) Amnion is the inner foetal membrane that surrounds the embryo. It produces an amniotic cavity filled with amniotic fluid. This fluid provided as safety measure against desiccation and shocks.

78. (c) Grey crescent is the area situated just opposite to the entry of sperm into ovum.

79. (a) Placenta is an endocrine gland, present only during pregnancy. It produces four hormones - estrogen, progesterone, hCG (human chorionic gonadotropins) and hPL (human placental lactogen).

Prolactin is produced in pituitary gland during lactogenesis.

80. (b) Cleavage is the process of zygote division immediately after the fertilisation. In this process rapid division occurs without the growth of cell & thus the size of cells reduces.

81. (a) Mammals undergo holoblastic rotational cleavage.

82. (a) Male & female gametes are fertilised to produce zygote which undergo cleavage in oviduct to form 8 - celled stage of embryo, morula. The morula continues to divide & form an organised blastula. This blastula is implanted into uterine lining and processed & divide further to form three germ layered stage of embryo called gastrula.

83. (a) In mammals, including humans, cleavage divisions are among the slowest in the animal kingdom. The amount of yolk and how it is distributed determines the type of cleavage. On this basis cleavage is of two types:

(a) Holoblastic - Cleavage divisions result in complete division of the zygote and the subsequent daughter cells, the blastomeres is known as holoblastic cleavage.

(b) Meroblastic - where segmentation line does not pass through the egg and remained confined to a part of the egg. It occurs in megalecithal (large amount of yolk) egg.

84. (a) In human, zygote undergo equal holoblastic cleavage as it moves through the isthmus of oviduct (fallopian tube).

85. (a) Trophoblast is the layer of cells encircling the blastocoel and the inner cell mass. The latter gives rise to the embryo. The cells of the trophoblast form the placenta and foetal membrane.

86. (a) Gastrulation is the process through which the presumptive areas of organ specific rudiments present on the surface of blastula move to their specific positions where these occur in the adult. At the termination of gastrulation, archenteron is formed at the place of blastocoel.

87. (b) Meroblastic is partial cleavage commonly occurs in telolecithal eggs (e.g. chick embryo), where only a part of egg (animal pole) which is opposite to yolky vegetal pole, undergo cleavage or division.

88. (a) Lens of eye is derived from the surface ectoderm and rest of the eye is derived mostly from neural ectoderm.

89. (b) Blastopore is the opening of archenteron (primitive gut) or gastrocoel formed by invagination of cells on embryo's surface during gastrulation. In protostome, blastopore becomes animal's mouth and in deuterostome it becomes the anus

90. (b) The term cleavage refers to a series of rapid mitotic divisions of the zygote following fertilisation, forming a many-celled blastula. Interphase in cleavage divisions is short and does not involve growth so that the resulting blastomeres become smaller in size as their number increases. Thus, the size of the cells (blastomeres) does not increase during cleavage.

91. (b) The egg released is haploid (has only one X-chromosome and 22 autosomes) as it is formed due to meiotic division of diploid primary oocyte having XX chromosome and 44 autosomes

92. (c) Gonads develop from the intermediate mesoderm that is situated in longitudinal urogenital ridges.

93. (a) Through the process of differentiation, a less specialised cell during development of multicellular organism and attains a specialised function with respect to position.

94. (c) At the end of pregnancy, vigorous contraction of the uterus causes expulsion or delivery of the foetus. This process of delivery of the foetus (childbirth) is called parturition. Parturition is induced by a complex neuroendocrine mechanism. Oxytocin acts on the uterine muscle and causes stronger uterine contractions. The levels of estrogen and progesterone also increases. Prostaglandins act on myometrium and stimulates uterine contractions. Prolactin is a lactation hormone that has no role in initiation of parturition.

95. (b) The process of child birth is called parturition which is induced by a complex neuroendocrine mechanism involving cortisol, estrogens and prostaglandins.

96. (b) The signals for parturition originate from the fully developed foetus and the placenta which induces mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from the maternal pituitary.

97. (c) Foetal ejection reflex accompanied by the release of oxytocin from posterior pituitary of mother.

98. (d) Signal for parturition originate from the fully developed foetus and placenta.

99. (b) Oxytocin secreted by posterior pituitary causes strong uterine contractions to facilitate parturition.

CHAPTER 3

Reproductive Health

Reproductive Health Problems and Strategies

1. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R. *(2023)*

Assertion A: Amniocentesis for sex determination is one of the strategies of Reproductive and Child Health Care Programme.

Reason R: Ban on amniocentesis checks increasing menace of female foeticide.

In the light of the above statements, Choose the correct answer from the options given below:

a. A is false but R is true.

b. Both A and R are true and R is the correct explanation of A.

c. Both A and R are true and R is NOT the correct explanation of A.

d. A is true but R is false.

2. In context of amniocentesis, which of the following statement is incorrect? *(2016 - I)*

a. It is usually done when a woman is between 14 - 16 weeks pregnant.

b. It is used for prenatal sex determination.

c. It can be used for detection of Down syndrome.

d. It can be used for detection of cleft palate.

3. Which of the following cannot be detected in a developing foetus by amniocentesis? *(2013)*

a. Jaundice b. Klinefelter's syndrome

c. Sex of the foetus d. Down syndrome

4. The present population of the world is about: *(1997)*

a. 15 trillion b. 6 billion

c. 500 million d. 100 million

5. Foetal sex can be determined by examining cells from the amniotic fluid by looking for: *(1997)*

a. Chiasmata b. Kinetochore

c. Barr bodies d. Autosomes

6. In India, human population is heavily weighed towards the younger age groups as a result of: *(1993)*

a. Short life span of many individuals and high birth rate

b. Long life span of many individuals and high birth rate

c. Short life span of many individuals and low birth rate

d. Long life span of many individuals and low birth rate

Population Stabilisation and Birth Control

7. Match List-I with List-II. [MR^] *(2023)*

List-I		List-II	
(A)	Vasectomy	(I)	Oral method
(B)	Coitus interruptus	(II)	Barrier method
(C)	Cervical caps	(III)	Surgical method
(D)	Saheli	(IV)	Natural method

Choose the correct answer from the options given below:

a. A-IV, B-II, C-I, D-III

b. A-III, B-I, C-IV, D-II

c. A-III, B-IV, C-II, D-I

d. A-II, B-III, C-I, D-IV

8. Match List-I with List-II. [MR^] *(2023-Manipur)*

List-I		List-II	
(A)	Non-medicated IUDs	(I)	Multiload 375
(B)	Copper releasing IUDs	(II)	Rubber barrier
(C)	Hormone releasing IUDs	(III)	Lippes loop
(D)	Vaults	(IV)	LNG-20

Choose the correct answer from the options given below:

a. A-IV, B-III, C-I, D-II

b. A-II, B-IV, C-III, D-I

c. A-III, B-I, C-IV, D-II

d. A-III, B-IV, C-II, D-I

9. Which of the following statements are correct? [MR^] *(2023-Manipur)*

A. Reproductive health refers to total well-being in all aspects of reproduction.

B. Amniocentesis is legally banned for sex determination in India.

C. "Saheli" – a new oral contraceptive for females was developed in collaboration with ICMR (New Delhi).

D. Amniocentesis is used to determine genetic disorders and survivability of foetus.

Choose the most appropriate answer from the options given below:

a. (B) and (C) only b. (D) and (C) only

c. (A), (B) and (D) only d. (A) and (C) only

10. Which of the following is not an Intra Uterine Device? *(2022 Re)*

a. Progestasert b. Progestogens

c. Multiload 375 d. Lippes loop

11. IUDs are small objects made up of plastic or copper that are inserted in the uterine cavity. *(2022 Re)*

Which of the following statements are correct about IUDs?

A. IUDs decrease phagocytosis of sperm within the uterus.

B. The released copper ions suppress the sperm motility.

C. IUDs do not make the cervix hostile to the sperm.

D. IUDs suppress the fertilization capacity of sperm.

E. The IUDs require surgical intervention for their insertion in the uterine cavity.

Choose the most appropriate answer from the options given below:

a. (D) only b. (A), (D) and (E) only

c. (B) and (C) only d. (B) and (D) only

12. Lippe's loop is a type of contraceptive used as: *(2022)*

a. Copper releasing IUD b. Cervical barrier

c. Vault barrier d. Non-Medicated IUD

13. Match List-I with List-II with respect to methods of Contraception and their respective actions. [MR^] *(2022)*

List-I		List-II	
(A)	Diaphragms	(i)	Inhibit ovulation and Implantation
(B)	Contraceptive Pills	(ii)	Increase phagocytosis of sperm within Uterus
(C)	Intra Uterine Devices	(iii)	Absence of Menstrual cycle and ovulation following parturition
(D)	Lactational Amenorrhea	(iv)	They cover the cervix blocking the entry of sperms

Choose the correct answer from the options given below.

a. A-iii B-ii C-i D-iv

b. A-iv B-i C-iii D-ii

c. A-iv B-I C-ii D-iii

d. A-ii B-iv C-i D-iii

14. Match List-I with List-II. *(2021)*

List-I		List-II	
(A)	Vaults	(i)	Entry of sperm through Cervix is blocked
(B)	IUDs	(ii)	Removal of Vas deferens
(C)	Vasectomy	(iii)	Phagocytosis of sperms within the Uterus
(D)	Tubectomy	(iv)	Removal of fallopian tube

Choose the correct answer from the options given below.

a. A-i B-iii C-ii D-iv

b. A-ii B-iv C-iii D-i

c. A-iii B-i C-iv D-ii

d. A-iv B-ii C-i D-iii

15. Which one of the following is an example of Hormone releasing IUD? *(2021)*

a. LNG 20 b. Cu 7

c. Multiload 375 d. CuT

16. Progestogens alone or in combination with estrogens can be used as a contraceptive in the form of- *(2020-Covid)*

a. Injections only b. Pills, injections and implants

c. Pills only d. Implants only

17. Select the hormone-releasing Intra-Uterine Devices. *(2019)*

a. Vaults, LNG-20 b. Multiload 375, Progestasert

c. Progestasert, LNG-20 d. Lippes Loop, Multiload 375

18. Which of the following contraceptive methods do involve a role of hormone? *(2019)*

a. Lactational amenorrhea, Pills, Emergency contraceptives.

b. Barrier method, Lactational amenorrhea, Pills.

c. CuT, Pills, Emergency contraceptives.

d. Pills, Emergency contraceptives, Barrier methods.

19. The contraceptive 'SAHELI': *(2018)*

a. Blocks estrogen receptors in the uterus, preventing eggs from getting implanted.

b. Increases the concentration of estrogen and prevents ovulation in females.

c. Is an IUD.

d. Is a post-coital contraceptive.

20. The function of copper ions in copper releasing IUD's is: *(2017-Delhi)*

a. They suppress sperm motility and fertilising capacity of sperms

b. They inhibit gametogenesis

c. They make uterus unsuitable for implantation

d. They inhibit ovulation

21. Which of the following is incorrect regarding vasectomy? *(2016 - II)*

a. Vasa deferentia is cut and tied

b. Irreversible sterility

c. No sperm occurs in seminal fluid

d. No sperm occurs in epididymis

22. Which of the following is hormone releasing IUD? *(2016 - II)*

a. Lippes loop b. Cu7

c. LNG-20 d. Multiload 375

23. Which of the following approaches does not give the defined action of contraceptive? *(2016 - I)*

a.	Barrier Methods	Prevent fertilisation
b.	Intrauterine	Increase phagocytosis of sperms, suppress sperm motility and fertilising capacity of sperms
c.	Hormonal contraceptives	Prevent retard entry of sperms, prevent ovulation and fertilisation
d.	Vasectomy	Prevents spermatogenesis

24. Hysterectomy is surgical removal of: *(2015)*
a. Vas deferens b. Mammary glands
c. Uterus d. Prostate gland

25. Tubectomy is a method of sterilisation in which: *(2014)*
a. Uterus is removed surgically
b. Small part of the fallopian tube is removed or tied up
c. Ovaries are removed surgically
d. Small part of vas deferens is removed or tied up

*. Which of the following is a hormone releasing Intra Uterine Device (IUD)? *(2014)*
a. Vault b. Multiload 375
c. LNG-20 d. Cervical cap

?. What is the figure given below showing in particular? *(2012 Pre)*

a. Vasectomy b. Ovarian cancer
c. Uterine cancer d. Tubectomy

28. Which one of the following is the most widely accepted method of contraception in India, as at present? *(2011 Pre)*
a. Cervical caps b. IUDs (Intra uterine devices)
c. Tubectomy d. Diaphragms

29. Cu ions of IUDs *(2010 Pre)*
a. Increase phagocytosis of sperms
b. Suppress sperm motility
c. Prevent ovulation
d. Make uterus unsuitable for implantation

30. Given below are four methods (A-D) and their modes of action (I-IV) in achieving contraception. Select the correct combination about contraceptives. [MR*] *(2010)*

	I		II
A	Pill	i.	Prevents sperm reaching cervix
B	Condom	ii.	Prevents implantation
C	Vasectomy	iii.	Prevents ovulation
D	Copper - T	iv.	Semen contains no sperm

a. A-iii B-iv C-i D-ii
b. A-iii B-ii C-i D-iv
c. A-iii B-i C-iv D-ii
d. A-ii B-i C-iv D-iii

31. What is the work of copper T? *(2009)*
a. To inhibit ovulation
b. To inhibit fertilisation
c. To inhibit implantation of blastocyst
d. To inhibit gametogenesis

32. What is the work of progesteron which is present in oral contraceptive pills? *(2009)*
a. To inhibit ovulation
b. To check oogenesis
c. To check entry of sperms in to cervix & to make them inactive
d. To check sexual behaviour

33. Which substance can be used as male contraceptive in future? *(1998)*
a. FSH b. LH
c. Testosterone d. Progesterone

34. Oral contraceptives contain: *(1994)*
a. Progesterone b. LH
c. Oxytocin d. Steroids

Medical Termination of Pregnancy And Sexual Transmitted Diseases

35. Which one of the following common sexually transmitted diseases is completely curable when detected early and treated properly? *(2015)*
a. HIV Infection b. Genital herpes
c. Gonorrhoea d. Hepatitis-B

36. Which of the following sexually transmitted infections is completely curable? *(2015-Manipur)*
a. HIV infection and Trichomoniasis
b. Syphilis and Trichomoniasis
c. Hepatitis - B and Genital herpes
d. Genital herpes and Genital warts

37. Venereal diseases can spread through *(20*
A. Using sterile needles
B. Transfusion of blood from infected person
C. Infected mother to foetus
D. Kissing
E. Inheritance
Choose the correct answer from the options given below
a. B, C and D only b. B and C only
c. A and C only d. A, B and C only

38. Select the option including all sexually transmitted diseases *(20*
a. Gonorrhoea, Malaria, Genital herpes
b. AIDS, Malaria, Filaria
c. Cancer, AIDS, Syphilis
d. Gonorrhoea, Syphilis, Genital herpes

39. Which of the following STDs are not curable? *(2020-Covid)*
a. Chlamydiasis, Syphilis, Genital warts
b. HIV, Gonorrhoea, Trichomoniasis
c. Gonorrhoea, Trichomoniasis, Hepatitis B
d. Genital herpes, Hepatitis B, HIV infection

40. Which of the following sexually transmitted diseases is not completely curable? *(2019)*
a. Gonorrhoea b. Genital warts
c. Genital herpes d. Chlamydiasis

41. Match the following sexually transmitted diseases (Column - I) with their causative agent (Column - II) and select the correct option. [MR*] *(2017-Delhi)*

Column - I	Column- II
A. Gonorrhea	i. HIV
B. Syphilis	ii. *Neisseria*
C. Genital Warts	iii. *Treponema*
D. AIDS	iv. Human Papilloma virus

a. A-ii B-iii C-iv D-i
b. A-iii B-iv C-i D-ii
c. A-iv B-ii C-iii D-i
d. A-iv B-iii C-ii D-i

42. Ectopic pregnancies are referred to as: *(2015 Re)*
a. Implantation of embryo at site other than uterus.
b. Implantation of defective embryo in the uterus.
c. Pregnancies terminated due to hormonal imbalance.
d. Pregnancies with genetic abnormality.

43. Which of the following is not a sexually transmitted disease? *(2015 Re)*
a. Trichomoniasis
b. Encephalitis
c. Syphilis
d. Acquired Immuno Deficiency Syndrome

44. One of the legal methods of birth control is: *(2013)*
a. By a premature ejaculation during coitus
b. Abortion by taking an appropriate medicine
c. By abstaining from coitus from day 10 to 17 of the menstrual cycle
d. By having coitus at the time of day break

45. Medical Termination of Pregnancy (MTP) is considered safe up to how many weeks of pregnancy? *(2011 Pre)*
a. Six weeks b. Eight weeks
c. Twelve weeks d. Eighteen weeks

46. Which two of the following statements are correct? [MR*] *(2008)*
A. MTP during first semester is generally safe
B. Chances of conception are nil until mother breast feeds the infant upto two years
C. IUDs like copper - T are effective contraceptives
D. Contraceptive pills may be taken upto one week after coitus to prevent conception
a. A, C b. A, B
c. B, C d. C, D

Infertility

47. Given below are two statements: *(2023-Manipur)*
Statement I: Intra Cytoplasmic Sperm Injection (ICSI) is another specialised procedure of *in-vivo* fertilisation.
Statement II: Infertility cases due to inability of the male partner to inseminate female can be corrected by artificial insemination (AI)
In the light of the above statements, choose the **correct** answer from the options given below.
a. **Statement I** is correct but **statement II** is incorrect
b. **Statement I** is incorrect but **Statement II** is correct
c. Both **Statement I** and **Statement II** are correct
d. Both **Statement I** and **Statement II** are incorrect.

48. In which of the following techniques, the embryos are transferred to assist those females who cannot conceive? [MR*] *(2020)*
a. GIFT and ZIFT b. ICSI and ZIFT
c. GIFT and ICSI d. ZIFT and IUT

49. In case of a couple where the male is having a very low sperm count, which technique will be suitable for fertilisation? *(2017-Delhi)*
a. Intrauterine transfer
b. Gamete intracytoplasmic fallopian transfer
c. Artificial Insemination
d. Intracytoplasmic sperm injection

50. Embryo with more than 16 blastomeres formed due to in vitro fertilisation is transferred into: *(2016 - II)*
a. Fimbriae b. Cervix
c. Uterus d. Fallopian tube

51. A childless couple can be assisted to have a child through a technique called GIFT. The full form of this technique is: *(2015 Re)*
a. Gamete intra fallopian transfer
b. Gamete internal fertilisation and transfer
c. Germ cell internal fallopian transfer
d. Gamete inseminated fallopian transfer

52. Assisted reproductive technology, IVF involves transfer of: *(2014)*
a. Embryo with 16 blastomeres into the fallopian tube
b. Ovum into the fallopian tube
c. Zygote into the fallopian tube
d. Zygote into the uterus

53. Artificial insemination means: *(2013)*
a. Introduction of sperms of healthy donor directly into the ovary
b. Transfer of sperms of a healthy donor to a test tube containing ova
c. Transfer of sperms of husband to a test tube containing ova
d. Artificial introduction of sperms of a healthy donor into the vagina

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54. The Test-tube Baby Programme employs which one of the following techniques? *(2012 Pre)*
a. Zygote intra fallopian transfer (ZIFT)
b. Intra cytoplasmic sperm injection (ICSI)
c. Intra uterine insemination (IUI)
d. Gamete intra fallopian transfer (GIFT)

55. The technique called gamete intrafallopian transfer (GIFT) is recommended for those females: *(2011 Mains)*
a. Whose cervical canal is too narrow to allow passage for the sperms
b. Who cannot provide suitable environment for fertilisation
c. Who cannot produce an ovum
d. Who cannot retain the foetus inside uterus

56. Test tube baby means a baby born when: *(2003)*
a. It is developed in a test tube
b. It is developed through tissue culture method
c. The ovum is fertilised externally and thereafter implanted in the uterus
d. It develops from a non-fertilised egg

57. The test tube baby means: *(1996)*
a. Fertilisation and development both in uterus
b. Fertilisation in *vitro* and then transplantation in uterus
c. A baby grown in test tube
d. Fertilised and developed embryo in test tube

58. Which of the following statements is correct with reference to a test tube baby? [MP^{A}] *(1996)*
a. Fertilisation of the egg is effected outside the body, the fertilised egg is then placed in the womb of the mother where the gestation is completed
b. Fertilisation of the egg is effected in the female genital tract. It is then taken out grown in a large test tube
c. A prematurely born baby is reared in an incubator
d. Fertilisation of the egg and growth of the embryo are affected in a large test tube

Answer Key

1. (a)	2. (d)	3. (a)	4. (b)	5. (c)	6. (a)	7. (c)	8. (c)	9. (c)	10. (b)
11. (d)	12. (d)	13. (c)	14. (a)	15. (a)	16. (b)	17. (c)	18. (a)	19. (a)	20. (a)
21. (d)	22. (c)	23. (d)	24. (c)	25. (b)	26. (c)	27. (d)	28. (b)	29. (b)	30. (c)
31. (b)	32. (a)	33. (c)	34. (a)	35. (c)	36. (b)	37. (a)	38. (d)	39. (d)	40. (c)
41. (a)	42. (a)	43. (b)	44. (b)	45. (c)	46. (a)	47. (b)	48. (d)	49. (c)	50. (c)
51. (a)	52. (c,d)	53. (d)	54. (a)	55. (c)	56. (c)	57. (b)	58. (a)		

Explanations

of some of the amniotic
etus and analysing the
foetal cells and dissolved substance. It can be done to detect genetic disorders, chromosomal abnormalities, biochemical defects, etc. It can also reveal a baby's gender. Statutory ban on amniocentesis for sex-determination have been done to legally check increasing menace of female foeticides. Its application of sex determination is not one of the strategies of Reproductive and Child Health Care Programme.

2. **(d)** Amniocentesis: A foetal sex determination test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo.

It cannot be used for detection of cleft palate(facial and oral malformations).

3. **(a)** Amniocentesis is a foetal sex determination test based on the chromosomal pattern in the ammiotic fluid surrounding the developing embryo. Jaundice is a condition not based on chromosomal pattern; it is caused due to liver dysfunctions.

4. **(b)** The current world population is 7.6 billion as of March 2018. As this question appeared in 1997, so the population of world in mid 1997 was 5.8, i.e., approx 6 billion.

5. **(c)** A Barr body is the inactive X chromosome in a female somatic cell. It is present at the periphery of nucleus as condensed chromatin, only in female somatic cells. Males lack these bodies.

6. **(a)** In India, the birth rate (natality) is quite high that is leading to a continuous growth of Indian population.

7. **(c)** Vasectomy is a surgical method of contraception in males. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum. Although sperm production continues in the testes, sperm can no longer reach the exterior. The sperm degenerate and are destroyed by phagocytosis.

Withdrawal or coitus interruptus is one of the natural methods of contraception in which the male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination.

Cervical caps are barriers that fit snugly over the cervix and block sperm from entering the uterus.

Saheli –the new oral contraceptive for the females contains a non-steroidal preparation. It is a 'once a week' pill with very few side effects and high contraceptive value.

8. **(c)** A-(III), B-(I), C-(IV), D-(II)
(A) Non- mediated IUDs - (III) Lippes loop
(B) Copper releasing IUDs - (I) Multiload 375
(C) Hormone releasing IUDs - (IV) LNG-20
(D) Vaults - (II) Rubber barrier

9. **(c)** (A), (B) and (D) only
Reproductive health encompasses total well-being in all aspects of reproduction. "Saheli" is a new oral contraceptive developed by the central Drug Research Institute (CDRI), Lucknow, India, not ICMR. Amniocentesis is used for determining genetic disorders and the survivability of the foetus and is legally banned in India for sex- determination.

10. **(b)** IUDs are devices inserted into the uterus to prevent pregnancy, and progestogens are hormones used in some contraceptives but are not devices themselves. Intrauterine Devices are presently available as the non-medicated IUDs (e.g. Lippes loop),copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormone releasing IUDs (Progestasert, LNG-20).

11. **(d)** IUDs
- increases phagocytosis of sperms within the uterus
- it makes the uterus unsuitable for implantation & the cervix hostile to the sperms.
- requires no surgical intervention for their insertion in the uterine cavity

12. **(d)** Intrauterine devices are inserted by doctors or expert nurses in the uterus through vagina. These Intra Uterine Devices are presently available as the non-medicated IUDs (e.g., Lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormone releasing IUDs (Progestasert, LNG-20).

13. **(c)** Diaphragms - They cover the cervix blocking the entry of sperms

Contraceptive pills - Inhibit ovulation and Implantation

Intra Uterine Devices - Increase phagocytosis of sperm within Uterus

Lactational Amenorrhea - Absence of Menstrual cycle and ovulation following parturition

14. **(a)** Vaults are barrier methods of contraception for female. These are made of rubber and prevent conception by blocking the entry of sperms through the cervix.

IUDs increase phagocytosis of sperms within the uterus.

Vasectomy is a surgical method of contraception in males in which a small part of the vas deferens is removed or tied up through a small incision on the scrotum.

Tubectomy is a surgical method of contraception in females where a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

15. **(a)** LNG 20 is an example of hormone releasing IUD.

CuT, Cu7 and multiload 375 are examples of copper releasing IUDs.

16. **(b)** Progestogens alone or in combination with estrogen can be used by females as pills and injections or implants under the skin.

17. **(c)** Progestasert and LNG-20 are hormone releasing IUDs which make the uterus unsuitable for implantation and the cervix hostile to sperms.

18. **(a)**
- In lactational amenorrhoea, due to high prolactin level, gonadotropin level decreases.
- Oral pills are either progestogens or progestogen-estrogen combinations used by the females.
- Emergency contraceptives includes the administration of progestogens or progestogen-estrogen combination or IUDs within 72 hour of coitus.

So, lactational amenorrhoea, oral pills and emergency contraceptives involves a role of hormone.

19. **(a)** SAHELI, the contraceptive pill acts anti-estrogenically and cause an asynchrony in menstrual cycle between ovulation and development of uterine lining. Thus, prevent the implantation.

20. **(a)** The Cu ions suppress motility and fertilising capacity of sperms.

21. **(d)** In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum whereas in tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina. These techniques are highly effective but their reversibility is very poor.

22. **(c)** The hormone releasing IUDs (Progestasert, LNG-20), make the uterus unsuitable for implantation and the cervix hostile to the sperms.

23. **(d)** Surgical intervention blocks gamete transport and thereby prevents conception. Sterilisation procedure in the male is called 'vasectomy' and in the female called 'tubectomy'.

24. **(c)** The surgical removal of all or part of the uterus is known as hysterectomy.

25. **(b)** Tubectomy: A small part of the fallopian tube is removed or tied up through a small incision in the abdomen to prevent transport of gamete.

26. **(c)** Hormone releasing IUD- (Progestasert, LNG 20)

27. **(d)** Surgical intervention blocks gamete transport and thereby prevents conception. Sterilisation procedure in the male is called 'vasectomy' and that in the female is called 'tubectomy'.

28. **(b)** Barrier methods (IUDs) are widely accepted in India.

29. **(b)** Cu ions suppress sperm motility and suppress the fertilizing capacity of sperms.

30. **(c)** Pill → Inhibits ovulation
Condom → Prevent sperms reaching cervix
Vasectomy → Semen contains no sperms
CuT → Prevents implantation

31. **(b)** Copper T (CuT) is a type of intrauterine contraceptive device, which is placed in uterus. It suppress sperm motility and increase phagocytosis of sperms thus preventing fertilisation.

32. **(a)** Progesterone with estrogen inhibits gonadotropin secretion and the level of LH & FSH in blood decreases, as a result, ovulation is blocked.

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33. **(c)** Male hormonal contraception can be done injecting testosterone. Its success rate as male contraceptive hormone alone is high as comparable to methods for women.

34. **(a)** Hormonal pills of contraception containing progesterone thickens cervical mucus to prevent sperm entry and makes uterus lining less receptive for implantation.

35. **(c)** Gonorrhoea is a sexually transmitted disease (STD) caused by the infection with bacterium *Neisseria gonorrhoeae*. Gonorrhoea can be cured with the proper treatment if detected early. HIV infections, genital herpes and hepatitis-B are incurable STDs.

36. **(b)** Syphilis and trichomoniasis are completely curable with proper treatment. HIV, Hepatitis B, and Genital herpes cannot be completely cured.

37. **(a)** Diseases or infections which are transmitted through sexual intercourse are collectively called sexually transmitted diseases (STD) or venereal diseases (VD). These can be spread by sharing of injection needles, surgical instruments, etc., transfusion of blood from infected person, or from an infected mother to the foetus too.

38. **(d)** Gonorrhoea, syphilis and genital herpes are sexually transmitted diseases.

39. **(d)** Diseases or infections which are transmitted through sexual intercourse are collectively called sexually transmitted diseases (STD). Except for hepatitis-B, genital herpes and HIV infections, other diseases are completely curable if detected early and treated properly.

40. **(c)** Genital herpes is caused by type-II-herpes simplex virus. At present there is no cure for type-II-herpes simplex virus and therefore the disease genital herpes is not curable. Other non-curable STDs are hepatitis-B and HIV.

41. **(a)** Gonorrhoea – *Neisseria* (Bacteria)

Syphilis – ***Treponema*** (Bacteria)

Genital Warts – Human papilloma virus (Virus)

AIDS – HIV (Virus)

42. **(a)** Implantation at site other than uterus is known as ectopic pregnancy.

43. **(b)** Diseases or an infection which are transmitted through sexual intercourse is called sexually transmitted diseases.

E.g., Gonorrhea, Syphilis, Genital herpes, Trichomoniasis, AIDS, Chlamydiases, etc.

44. **(b)** Medical termination of pregnancy (MTP) or induced abortion become legal in India in 1971 with some strict conditions to avoid its misuse.

45. **(c)** MTP (Medical Transmission of pregnancy): Safe upto 12 weeks of pregnancy.

46. **(a)** MTP are considered relatively safe during the first trimester. Chances of contraception are all most mother breast feeds the infant upto a maximum period of 6 months. CuT is effective contraceptives.

47. **(3)** (2) Statement I is incorrect but Statement II is correct.

Intra Cytoplasmic Sperm Injection (ICSI) is a specialised procedure of *in vitro* fertilisation (IVF), not *in vivo*, where a single sperm is injected directly into an egg. Artificial insemination (AI) is a technique used to treat certain types of infertility, including cases where the male partner has low sperm count or motility.

48. **(d)** Embryos formed by *in-vivo* fertilisation (fusion of gametes within the female) or embryo transfer (ET) could be used for such transfer to assist those females who cannot conceive. In embryo transfer (ET), the zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer) and embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development.

49. **(c)** Artificial insemination (AI) technique: The semen collected from the husband or a healthy donor is artificially introduced into the vagina or the uterus (IUI intra-uterine insemination) of the female.

This technique is useful for the male partner having inability to inseminate female or low sperm counts etc.

50. **(c)** The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT - Zygote Intra Fallopian Transfer) and embryos with more than 8 blastomeres, into the uterus (IUT – Intra Uterine Transfer) to complete its further development.

51. **(a)** GIFT - Gamete intra fallopian transfer.

52. **(c,d)** IVF involves ZIFT and IUT. ZIFT involves transfer of zygote upto 8 blastomeres in fallopian tube. IUT involves transfer of zygote (more than 8 blastomeres) in the uterus.

53. **(d)** Artificial insemination is a technique used to correct infertility cases caused due to inability of the male partner to inseminate the female or due to law sperm counts in the ejaculates.

54. **(a)** In vitro fertilisation (IVF–fertilisation outside the body in almost similar conditions as that in the body) followed by embryo transfer (ET) is one of such methods. In this method, popularly known as test tube baby programme, ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory. This method is followed by ZIFT.

55. **(c)** The technique called gamete intrafallopian transfer (GIFT) is recommended for those females who cannot produce an ovum. In GIFT, transfer of an ovum from a donor into the fallopian tube of another female who cannot produce ovum, but can provide suitable environment for fertilization and development.

56. **(c)** Test tube baby is produced by *in-vitro* fertilisation, in which egg is combined with sperm outside the body, in-vitro (thus name test tube). The fertilised egg undergoes embryo culture for 2-6 days and is then transferred to the uterus.

57. **(b)** Test tube baby is a term that refers to a child that is conceived outside the women's body by a scientific process IVF. After the culture of fertilised egg as embryo for few days, the embryo is implanted to the lining of uterus.

58. **(a)** IVT (in-vitro fertilisation) is used to produce test-tube baby. Fertilised egg is then transferred to womb of mother after 4 - 6 days of fertilisation and then embryo undergo normal development.

CHAPTER 4 Principles of Inheritance and Variation

Mendal's Laws of Inherita[illegible]nd Inheritance of One G[illegible]

1. A heterozygous pea plant with violet flowers was crossed with homozygous pea plant with white flower. Violet is dominant over white. Which one of the following represents the expected combinations among 40 progenies formed? *(2023-Manipur)*

a. 30 produced violet and 10 produced white flowers
b. 20 produced violet and 20 produced white flowers
c. All 40 produced violet flowers
d. All 40 produced white flowers

2. Given below are two statements:

Statement I: Mendel studied seven pairs of contrasting traits in pea plants and proposed the Laws of Inheritance.

Statement II: Seven characters examined by Mendel in his experiment on pea plants were seed shape and colour, flower colour, pod shape and colour, flower position and stem height.

In the light of the above statements, choose the correct answer from the options given below. *(2022)*

a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both statement I and statement II are incorrect
d. Statement I is correct but Statement II is incorrect

3. The production for gametes by the parents, formation of zygotes, the F_1 and F_2 plants,can be understood from a diagram called: *(2021)*

a. Punch square
b. Punnett square
c. Net square
d. Ballet square

4. Identify the wrong statement with reference to the gene 'I' that controls ABO blood groups. *(2020)*

a. A person will have only two of the three alleles.
b. When I^A and I^B are present together, they express same type of sugar.
c. Allele 'i' does not produce any sugar
d. The gene *I* has three alleles.

5. How many true breeding pea plant varieties did Mendel select as pairs, which were similar except in one character with contrasting traits? *(2020)*

a. 2 b. 14
c. 8 d. 4

6. The number of contrasting characters studied by Mendel for his experiments was: *(2020-Covid)*

a. 4 b. 2
c. 7 d. 14

7. In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1 generation pink flowers were obtained. When pink flowers were selfed, the F_2 generation showed white, red and pink flowers. Choose the incorrect statement from the following : *(2019)*

a. This experiment does not follow the principle of dominance.
b. Pink colour in F_1 is due to incomplete dominance.
c. Ratio of F_2 is $\frac{1}{4}$ (Red) : $\frac{2}{4}$ (Pink) : $\frac{1}{4}$ (White)
d. Law of segregation does not apply in this experiment

8. Which of the following characteristics represent Inheritance of blood groups' in humans? *(2019)*

A. Dominance B. Co-dominance
C. Multiple alleles D. Incomplete dominance
E. Polygenic inheritance

a. B, C and E b. A, B and C
c. B, D and E d. A, C and E

9. Among the following characters, which one was not considered by Mendel in his experiments on pea? *(2017-Delhi)*

a. Stem - Tall or Dwarf
b. Trichomes - Glandular or non-glandular
c. Seed - Green or Yellow
d. Pod - Inflated or Constricted

10. The genotypes of a Husband and Wife are I^AI^B and I^Ai. Among the blood types of their children, how many different genotypes and phenotypes are possible? *(2017-Delhi)*

a. 3 genotypes ; 3 phenotypes
b. 3 genotypes ; 4 phenotypes
c. 4 genotypes ; 3 phenotypes
d. 4 genotypes ; 4 phenotypes

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11. Which one from those given below is the period for Mendel's hybridisation experiments? *(2017-Delhi)*
a. 1856 - 1863 b. 1840 - 1850
c. 1857 - 1869 d. 1870 - 1877

12. A true breeding plant is: *(2016 - II)*
a. Nearly homozygous and producees offspring of its own kind
b. Always homozygous recessive in its genetic constitution
c. One that is able to breed on its own
d. Produced due to cross-pollination among unrelated plants

13. In a test cross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. This indicates *(2016 - I)*
a. The two genes are located on two different chromosomes
b. Chromosomes failed to separate during meiosis
c. The two genes are linked and present on the same chromosome
d. Both of the characters are controlled by more than one gene

14. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed the resulting genotypes were in the ratio of: *(2016 - I)*
a. 1 : 2 : 1 : Tall homozygous : Tall heterozygous : Dwarf
b. 1 : 2 : 1 : Tall heterozygous : Tall homozygous : Dwarf
c. 3 : 1 : Tall : Dwarf
d. 3 : 1 : Dwarf : Tall

How many pairs of contrasting characters in pea plants were studied by Mendel in his experiments? *(2016 - I)*
a. Eight b. Seven
c. Five d. Six

A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offspring's? *(2016 - I)*
a. A, B, AB and O b. O only
c. A and B only d. A, B and AB only

Multiple alleles are present: *(2015)*
a. At the same locus of the chromosome
b. On non-sister chromatids
c. On different chromosomes
d. At different loci on the same chromosome

18. Alleles are: *(2015)*
a. Different molecular forms of a gene
b. Heterozygote's
c. Different phenotype
d. True breeding homozygote's

19. A gene showing co-dominance has: *(2015 Re)*
a. Alleles tightly linked on the same chromosome
b. Alleles that is recessive to each other
c. Both alleles independently expressed in the heterozygote
d. One allele dominant on the other

20. In his classic experiments on pea plants, Mendel did not ... *(2013 M...*
a. Pod length b. Seed shape
c. Flower position d. Seed colour

21. If two persons with 'AB' blood group marry and ha... sufficiently large number of children, these children co... be classified as 'A' blood group : 'AB' blood group : ... blood group in 1 : 2 : 1 ratio. Modern technique of ... electrophoresis reveals presence of both 'A' and 'B' ... proteins in 'AB' blood group individuals. This is an example of: *(201...*
a. Complete dominance b. Co-dominance
c. Incomplete dominance d. Partial dominance

22. Which Mendelian idea is depicted by a cross in which the ... generation resembles both the parents? *(201...*
a. Co-dominance b. Incomplete dominance
c. Law of dominance d. Inheritance of one gene

23. A test cross is carried out to: *(2012 Mains)*
a. Determine the genotype of a plant at F_2
b. Predict whether two traits are linked
c. Assess the number of alleles of a gene
d. Determine whether two species or varieties will breed successfully

24. F_2 generation in a Mendelian cross showed that both genotype and phenotypic ratios are same as 1: 2: 1. It represents a cross of: *(2012 Pre...*
a. Monohybrid cross with incomplete dominance
b. Co-dominance
c. Dihybrid cross
d. Monohybrid cross with complete dominance

25. Test cross in plants or in *Drosophila* involves crossing: *(2011 Mains)*
a. The F_1 hybrid with a double recessive genotype
b. Between two genotypes with dominant trait
c. Between two genotypes with recessive trait
d. Between two F_1 hybrids

26. In *Antirrhinum* two plants with pink flowers were hybridised. The F_1 plants produced red, pink and white flowers in ratio of 1: 2: 1. What could be genotype of the parent plants, (RR is red and rr is white)? *(2010 Mains)*
a. rr b. Rr
c. RR d. rrrr

27. Which one of the following cannot be explained on the basis of Mendel's law of Dominance? *(2010 Pre)*
a. Out of one pair of factors, one is dominant and the other is recessive
b. Alleles do not show any blending and both the characters recover as such in F_2 generation
c. Factors occur in pairs
d. Discrete unit controlling a particular character is called a factor

28. Heterozygosity/dominance of phenotype can be determined by: *(2010 Pre)*
a. Back cross b. Test cross
c. Reciprocal cross d. Hybrid cross

29. The number of phenotypes in ABO blood group is: *(2010 Pre, Mains)*
a. 1 b. 4
c. 6 d. 8

30. Test cross involves: *(2006)*
a. Crossing between two genotypes with dominant trait
b. Crossing between two genotypes with recessive trait
c. Crossing the F_1 hybrid with double recessive genotype
d. Crossing between two F_1 hybrids

31. For finding the different types of gametes produced by genotype AaBb, it should be crossed with genotype: *(2005)*
a. AABB b. aabb
c. AaBb d. aaBB

32. In the ABO system of blood groups if both antigens are present but no antibody, the blood group of the individual would be: *(2004)*
a. O b. AB
c. A d. B

33. Two crosses between the same pair of genotypes or phenotypes in which the sources of the gametes are reversed in one cross, is known as: *(2003)*
a. Test cross b. Reciprocal cross
c. Dihybrid cross d. Reverse cross

34. The genes controlling the seven pea characters studied by Mendel are now known to be located on how many different chromosomes? *(2003)*
a. Seven b. Six
c. Five d. Four

35. Which one of the following traits of garden pea studied by Mendel was a recessive feature? *(2003)*
a. Axial flower position b. Green seed colour
c. Green pod colour d. Round seed shape

36. A gene said to be dominant if: *(2002)*
a. It express it's effect only in homozygous stage
b. It expressed only in heterozygous condition
c. It expressed both in homozygous and heterozygous condition.
d. It never expressed in any condition.

37. Mendel obtained wrinkled seeds in pea due to deposition of sugars instead of starch. It was due to which enzyme? *(2001)*
a. Amylase
b. Invertase
c. Diastase
d. Absence of starch branching enzyme

38. When dominant and recessive allels express itself together it is called: *(2001)*
a. Co-dominance b. Dominance
c. Amphidominance d. Pseudo-dominance

39. According to Mendelism, which character is showing dominance? *(2000)*
a. Terminal position of flower
b. Green colour in seed coat
c. Wrinkled seeds
d. Green pod colour

40. The allele for tallness is dominant over that of dwarfness. This is called: *(1999)*
a. Law of independent assortment
b. Law of segregation
c. Law of unit character
d. Law of dominance

41. ABO blood group have: *(1998)*
a. Two codominant and one recessive allele
b. Two codominant and two recessive allele
c. Two incompletely dominant genes
d. Two pseudoalleles

42. Genes located at the same locus of chromosomes are called: *(1997)*
a. Multiple alleles b. Polygenes
c. Oncogenes d. None of these

43. When two genetic loci produce identical phenotypes in *cis* and *trans* position, they are considered to be: *(1995)*
a. Multiple alleles b. The parts of same gene
c. Pseudoalleles d. Different genes

44. A child of O-group has B-group father. The genotype of father will be: *(1992)*
a. I^Bi b. I^BI^B
c. I^Ai d. I^AI^B

45. An allele is dominant if it is expressed in: *(1992)*
a. Both homozygous and heterozygous states
b. Second generation
c. Heterozygous combination
d. Homozygous combination

46. Segregation of Mendelian factors (no linkage, no crossing over) occurs during: *(1992)*
a. Anaphase I b. Anaphase II
c. Diplotene d. Metaphase I

47. An organism with two identical alleles is: *(1992)*
a. Dominant b. Hybrid
c. Heterozygous d. Homozygous

48. A man of A-blood group marries a women of AB blood group. Which type of progeny would indicate that man is heterozygous A? *(1991)*
a. AB b. A
c. O d. B

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86. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Mendel's law of Independent assortment does not hold good for the genes that are located closely one the same chromosome.

Reason (R): Closely located genes assort independently.

In the light of the above statements, choose the correct answer from the options given below. *(2022)*

a. (A) is not correct but (R) is correct
b. Both (A) and (R) are correct and (R) is the correct explanation of (A)
c. Both (A) and (R) are correct but (R) is not the correct explanation of (A)
d. (A) is correct but (R) is not correct

87. The best example for pleiotropy is: *(2020-Covid)*

a. Phenylketonuria b. Colour Blindness
c. ABO Blood group d. Skin colour

88. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was explained by *(2019)*

a. T.H. Morgan b. Gregor J. Mendel
c. Alfred Sturtevant d. Sutton Boveri

89. Select the correct statement: *(2018)*

a. Franklin Stahl coined the term "linkage".
b. Punnett square was developed by a British scientist.
c. Spliceosomes take part in translation.
d. Transduction was discovered by S. Altman.

90. Match the terms in Column I with their description in Column II and choose the correct option **[MR³]** *(2016 - I)*

	Column I		Column II
A.	Dominance	i.	Many genes govern a single character
B.	Co-dominance	ii.	In a heterozygous organism only one allele expresses itself
C.	Pleiotropy	iii.	In a heterozygous organism both alleles express themselves fully
D.	Polygenic inheritance	iv.	A single gene influences many characters

a. A-(ii), B-(i), C-(iv), D-(iii)
b. A-(ii), B-(iii), C-(iv), D-(i)
c. A-(iv), B-(i), C-(ii), D-(iii)
d. A-(iv), B-(iii), C-(i), D-(ii)

91. The movement of a gene from one linkage group to another is called: *(2015)*

a. Translocation b. Crossing over
c. Inversion d. Duplication

92. The term "linkage" was coined by: *(2015 Re)*

a. T. Boveri b. G. Mendel
c. W. Sutton d. T.H. Morgan

93. A pleiotropic gene: *(2015 Re)*

a. Is a gene evolved during Pliocene
b. Controls a trait only in combination with another gene
c. Controls multiple traits in an individual
d. Is expressed only in primitive plants

94. Which of the following statements is not true for two genes that show 50% recombination frequency? *(2013)*

a. If the genes are present on the same chromosome, they undergo more than one crossover in every meiosis
b. The genes may be on different chromosomes
c. The genes are tightly linked
d. The genes show independent assortment

95. Phenotype of an organism is the result of: *(2006)*

a. Mutations and linkages
b. Genotype and environment interactions
c. Cytoplasmic effects and nutrition
d. Environmental changes and sexual dimorphism

96. Lack of independent assortment of two genes A and B in fruit fly *Drosophila* is due to: *(2004)*

a. Recombination b. Linkage
c. Crossing over d. Repulsion

97. The linkage map of X-chromosome of fruitfly has 66 units with yellow body gene (y) at one end and bobbed hair (b) gene at the other end. The combination frequency between these two genes (y and b) should be: *(2001)*

a. 60% b. > 50%
c. ≤ 50% d. 100%

98. Genetic map is one that: *(2000)*

a. Establishes sites of the genes on a chromosome
b. Establishes the various stages in gene evolution
c. Shows the stages during the cell division
d. Shows the distribution of various species in a region

99. When a cluster of genes show linkage behaviour they *(2000)*

a. Do not show a chromosome map
b. Show recombination during meiosis
c. Do not show independent assortment
d. Induce cell division

100. Which of the following is the example of pleiotropic gene? *(2002)*

a. Haemophilia b. Thalassemia
c. Sickle cell anaemia d. Colour blindness

101. There are three genes a, b and c. The percentage of crossing over between a and b is 20%, b and c is 28% and a and c is 8%. What is the sequence of genes on chromosome? *(2002)*

a. b, a, c b. a, b, c
c. a, c, b d. None of these

102. A plant of F_1-generation with genotype "AABbCC". On selfing of this plant what is the phenotypic ratio in F_2-generation? *(2002)*

a. 3 : 1 b. 1 : 1
c. 9 : 3 : 3 : 1 d. 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1

103. A and B genes are linked. What shall be genotype of progeny in a cross between AB/ab and ab/ab? *(2001)*

a. AAbb and aabb b. AaBb and aabb
c. AABB and aabb d. None of these

104. Irregularity is found in *Drosophila* during the organ differentiation, for example- in place of wing, long legs are formed. Which gene is responsible? *(2000)*

a. Double dominant gene b. Homeotic gene
c. Complimentary gene d. Plastid

105. When AABBcc is crossed with AaBbCc then the ratio of hybrid for all the three genes is: *(1999)*

a. 1/8 b. 1/4
c. 1/16 d. 1/32

106. AABbCc genotypes forms how many types of gametes? *(1998)*

a. 4 b. 8
c. 2 d. 6

107. The polygenic genes show: *(1996)*

a. Different karyotypes b. Different genotypes
c. Different phenotypes d. None of these

108. Which of the following is suitable for experiment on linkage? *(1993)*

a. aaBB x aaBB b. AABB x aabb
c. AaBb x AaBb d. AAbb x AaBB

109. Mendel studied inheritance of seven pairs of traits in Pea which can have 21 possible combinations. If you are told that in one of these combinations, independent assortment is not observed in later studies, your reaction will be: *(1993)*

a. Independent assortment principle may be wrong
b. Mendel might not have studied all the combinations
c. It is impossible
d. Later studies may be wrong

110. Two dominant nonallelic genes are 50 map units apart. The linkage is: *(1993)*

a. Cis type b. Trans type
c. Complete d. Absent/incomplete

111. A polygenic inheritance in human beings is: *(1993)*

a. Skin colour b. Phenylketonuria
c. Colour blindness d. Sickle cell anaemia

112. Bateson used the terms coupling and repulsion for linkage and crossing over. Name the correct parental of coupling type along with its cross over or repulsion: *(1990)*

a. Coupling AABB, aabb; Repulsion AABB, aabb
b. Coupling AAbb, aaBB; Repulsion AaBb, aabb
c. Coupling aaBB, aabb; Repulsion AABB, aabb
d. Coupling AABB, aabb; Repulsion AAbb, aaBB

Sex Determination And Mutation

113. Select the **correct** statement's with respect to mechanism of sex determination in Grasshopper. *(2023-Manipur)*

A. It is an example of female heterogamety.
B. Male produces two different types of gametes either with or without X chromosome.
C. Total number of chromosomes (autosomes and sex chromosomes) is same in both males and females.
D. All eggs bear an additional X chromosome besides the autosomes.

Choose the **correct** answer from the options given below:

a. (B) and (D) only b. (A), (C) and (D) only
c. (A) only d. (A) and (C) only

114. Select the incorrect statement. **[MR³]** *(2019)*

a. Male fruit fly is heterogametic
b. In male grasshoppers 50% of sperms have no sex-chromosome
c. In domesticated fowls, sex of progeny depends on the type of sperm rather than egg
d. Human males have one of their sex-chromosome much shorter than the other

115. Which of the following pairs is wrongly matched? **[MR³]** *(2018)*

a. Starch synthesis in pea : Multiple alleles
b. ABO blood grouping : Co-dominance
c. XO type sex determination : Grasshopper
d. T.H. Morgan : Linkage

116. An abnormal human baby with 'XXX' sex chromosomes was born due to: *(2015)*

a. Fusion of two ova and one sperm
b. Fusion of two sperms and one ovum
c. Formation of abnormal sperms in the father
d. Formation of abnormal ova in the mother

117. Which one of the following conditions correctly describes the manner of determining the sex in the given example? **[MR³]** *(2011 Pre)*

a. Homozygous sex chromosomes (XX) produce male in *Drosophila*
b. Homozygous sex chromosomes (ZZ) determine female sex in birds
c. XO type of sex chromosomes determine male sex in grasshopper
d. XO condition in humans as found in Turner Syndrome, determines female sex

118. Which one of the following conditions of the zygotic cell would lead to the birth of a normal human female child? *(2011 Mains)*

a. Only one X chromosome
b. One X and one Y chromosome
c. Two X chromosome
d. Only one Y chromosome

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119. A human male produce diallelic sperms in equal proportion AB, Ab, aB and ab. The genotype of the person would be: *(2007)*

a. AaBb b. AaBB
c. AABb d. AABB

120. One of the parents of a cross has a mutation in its mitochondria, in that cross, that parent is taken as a male. During segregation of F_1 progenies that mutation is found in: *(2004)*

a. None of the progenies b. All the progenies
c. 50% of the progenies d. 1/4 of the progenies

121. In *Drosophila*, the sex is determined by: *(2003)*

a. The ratio of number of X-chromosomes to the sets of autosomes
b. X and Y chromosomes
c. The ratio of pairs of X-chromosomes to the pairs of autosomes
d. Whether the egg is fertilised or develops parthenogenetically

122. Male XX and female XY sometime occur due to: *(2001)*

a. Deletion
b. Transfer of segments in X and Y chromosomes
c. Aneuploidy
d. Hormonal imbalance

123. No. of Barr Body in XXXX female: *(2001)*

a. 1 b. 2
c. 3 d. 4

124. Extranuclear inheritance occurs in: *(2001)*

a. Killer *Paramoecium* b. Killer *Amoeba*
c. *Euglena* d. *Hydra*

125. Genetic identity of a human male is determined by: *(1997)*

a. Sex chromosome b. Cell organelles
c. Autosome d. Nucleolus

126. A fruit fly is heterozygous for sex-linked genes, when mated with normal female fruit fly, the males specific chromosome will enter egg cell in the proportion: *(1997)*

a. 3 : 1 b. 7 : 1
c. 1 : 1 d. 2 : 1

127. Barr body in mammals represents: *(1995)*

a. All the heterochromatin in male and female cells
b. The Y chromosome in somatic cells of male
c. All the heterochromatin in female cells
d. One of the two X-chromosomes in somatic cells of females

128. The most striking example of point mutation is found in a disease called: *(1995)*

a. Down's syndrome b. Sickle cell anaemia
c. Thalassemia d. Night blindness

129. The genes, which remain confined to differential region of Y-chromosome, are: *(1994)*

a. Autosomal genes
b. Holandric genes
c. Completely sex-linked genes
d. Mutant genes

130. Mr. Kapoor has Bb autosomal gene pair and *d* allele is sex-linked. What shall be proportion of Bd in sperms? *(1994)*

a. Zero b. 1/2
c. 1/4 d. 1/8

131. Sex is determined in human beings: *(1993)*

a. By ovum
b. At time of fertilisation
c. 40 days after fertilisation
d. Seventh to eight week when genitals differentiate in female

132. A family of five daughter only is expecting sixth child. The chance of its beings a son is: *(1990)*

a. Zero b. 25%
c. 50% d. 100%

133. Haploids are able to express both recessive and dominant alleles/mutations because there are: *(1990)*

a. Many alleles for each gene
b. Two alleles for each gene
c. Only one allele for each gene in the individual
d. Only one allele in a gene

Genetic Disorders

134. Which of the following statements are correct about Klinefelter's Syndrome? *(2021)*

A. This disorder was first described by Langdon Down (1866)
B. Such an individual has overall masculine development. However, the feminine development is also expressed.
C. The affected individual is short stature.
D. Physical, psychomotor and mental development is retarded
E. Such individuals are sterile.

Choose the correct answer from the options given below:

a. A and E only b. A and B only
c. C and D only d. B and E only

135. Which one of the following symbols represents mating between relatives in human pedigree analysis? *(2021)*

a. ■ ● ◆ b. □—○
c. □═○ d. □—○ (with ■)

136. Broad palm with single palm crease is visible in a person suffering from- *(2020)*

a. Thalassemia b. Down's syndrome
c. Turner's syndrome d. Klinefelter's syndrome

137. Given below are two statements: *(2022 Re)*

Statement-I: Sickle cell anaemia and Haemophilia are autosomal dominant traits.

Statement-II: Sickle cell anaemia and Haemophilia are disorders of the blood.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both Statement I and Statement II are incorrect
d. Statement I is correct but Statement II is incorrect

138. If a female individual is with small round head, furrowed tongue, partially open mouth and broad palm with characteristic palm crease. Also the physical, psychomotor and mental development is retarded. The karyotype analysis of such an individual will show [MR*] *(2022 Re)*

a. Trisomy of chromosome 21
b. 47 chromosomes with XXY sex chromosomes
c. 45 chromosomes with XO sex chromosomes
d. 47 Chromosomes with XYY sex chromosomes

139. Select the incorrect match regarding the symbols used in Pedigree analysis *(2022 Re)*

a. ■—○ Parent with male child affected with disease
b. ◇ Sex unspecified
c. ■ Affected individual
d. □—○ Consanguineous mating

140. A normal girl, whose mother is haemophilic marries a male with no ancestral history of haemophilia. What will be the possible phenotypes of the offsprings? *(2022 Re)*

A. Haemophilic son and haemophilic daughter.
B. Haemophilic son and carrier daughter.
C. Normal daughter and normal son.
D. Normal son and haemophilic daughter.

Choose the most appropriate answer from the options given below:

a. (B) and (D) only b. (A) and (B) only
c. (B) and (C) only d. (A) and (D) only

141. Which of the following occurs due to the presence of autosome linked dominant trait? *(2022)*

a. Thalassemia b. Sickle cell anaemia
c. Myotonic dystrophy d. Haemophilia

142. If a colour blind female marries a man whose mother was also colour blind, what are the chances of her progeny having colour blindness? *(2022)*

a. 100% b. 25%
c. 50% d. 75%

143. In a cross between a male and female, both heterozygous for sickle cell anaemia gene, what percentage of the progeny will be diseased? *(2021)*

a. 75% b. 25%
c. 100% d. 50%

144. Select the correct match [MR*] *(2020)*

	Column - I		Column - II
a.	Phenylketonuria	-	Autosomal dominant trait
b.	Sickle cell anaemia	-	Autosomal recessive trait, chromosome-11
c.	Thalassemia	-	X linked
d.	Haemophilia	-	Y linked

145. What is the genetic disorder in which an individual has an overall masculine development gynaecomastia, and is sterile? *(2019)*

a. Turner's syndrome b. Klinefelter's syndrome
c. Edward syndrome d. Down's syndrome

146. A woman has an X-linked condition on one of her X chromosomes. This chromosome can be inherited by: *(2018)*

a. Only daughters b. Only sons
c. Only grandchildren d. Both sons and daughters

147. A disease caused by an autosomal primary non-disjunction is *(2017-Delhi)*

a. Down's syndrome b. Klinefelter's syndrome
c. Turner's syndrome d. Sickle cell anemia

148. Thalassemia and sickle cell anemia are caused due to a problem in globin molecule synthesis. Select the correct statement. [MR*] *(2017-Delhi)*

a. Both are due to a qualitative defect in globin chain synthesis
b. Both are due to a quantitative defect in globin chain synthesis
c. Thalassemia is due to less synthesis of globin molecules
d. Sickle cell anemia is due to a quantitative problem of globin molecules

149. If a colour-blind man marries a woman who is homozygous for normal colour vision, the probability of their son being colour-blind is: *(2016 - II)*

a. 0.75 b. 1
c. 0 d. 0.5

150. Pick out the correct statements: [MR*] *(2016 - I)*

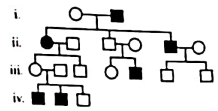
A. Haemophilia is a sex-linked recessive disease.
B. Down's syndrome is due to aneuploidy.
C. Phenylketonuria is an autosomal recessive gene disorder.
D. Sickle cell anaemia is an X-linked recessive gene disorder.

a. (A) and (D) are correct
b. (B) and (D) are correct
c. (A), (C) and (D) are correct
d. (A), (B) and (C) are correct

151. Which of the following most appropriately describes haemophilia? *(2016 - I)*

a. Recessive gene disorder
b. X-linked recessive gene disorder
c. Chromosomal disorder
d. Dominant gene disorder

152. In the following human pedigree, the filled symbols represent the affected individuals. Identify the type of given pedigree. *(2015 Re)*



a. X-linked recessive b. Autosomal recessive
c. X-linked dominant d. Autosomal dominant

153. A colour blind man marries a woman with normal sight who has no history of colour blindness in her family. What is the probability of their grandson being colour blind? *(2015 Re)*

a. 1 b. Nil
c. 0.25 d. 0.5

154. A human female with Turner's syndrome: *(2014)*

a. Is able to produce children with normal husband
b. Has 45 chromosomes with XO
c. Has one additional X chromosome
d. Exhibits male characters

155. A man whose father was colour blind marries a woman who had a colour blind mother and normal father. What percentage of male children of this couple will be colour blind? *(2014)*

a. 75% b. 25%
c. 0% d. 50%

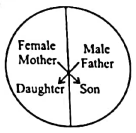
156. The incorrect statement with regard to Haemophilia is: *(2013)*

a. A single protein involved in the clotting of blood is affected
b. It is a sex - linked disease
c. It is a recessive disease
d. It is a dominant disease

157. If both parents are carriers for Thalassaemia, which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child? *(2013)*

a. 100% b. No chance
c. 50% d. 25%

158. Represented below is the inheritance pattern of a certain type of traits in humans. Which one of the following conditions ild be an example of this pattern? *(2012 Mains)*

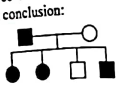


. Phenylketonuria b. Sickle cell anemia
. Haemophilia d. Thalassemia

159. A normal-visioned man, whose father was colour-blind, marries a woman whose father was also colour-blind. They have their first child as a daughter. What are the chances that this child would be colour-blind? *(2012 Pre)*

a. 50% b. 100%
c. Zero percent d. 25%

160. Study the pedigree chart of certain family given here and select the correct conclusion: *(2010 Mains)*



a. The female parent is heterozygous
b. The parents could not have a normal daughter for this character
c. The trait under study could not be color blindness
d. The male parent is homozygous dominant

161. Which one of the following symbols and is representation, used in human pedigree analysis its correct? *(2010 Pre)*

a. ◯ = unaffected male
b. □ = unaffected female
c. ◆ = male affected
d. □—◯ = mating between relatives

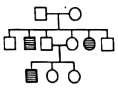
162. Select the incorrect statement from the following: *(2009)*

a. Baldness is a sex-limited trait
b. Linkage is an exception to the principle of independent assortment
c. Galactosemia is an inborn error of metabolism
d. Small population size results in random genetic drift in a population

163. Sickle cell anemia is: *(2009)*

a. Characterised by elongated sickle-like RBCs with a nucleus
b. Caused by substitution of valine by glutamic acid in beta-globulin chain of haemoglobin
c. Caused by a change in a single base pair of DNA
d. An autosomal linked dominant trait

164. Study the pedigree chart. What does it show? *(2009)*



a. Inheritance of a condition like phenylketonuria as an autosomal recessive trait
b. Inheritance of a recessive sex-linked disease like haemophilia
c. Inheritance of sex-linked inborn error of metabolism like phenylketonuria
d. Pedigree chart is wrong as this is not possible

165. Which one is correctly matched? *(2008)*

a. Erythroblastosis syndrome - X-linked
b. Down's syndrome - 44A + XO
c. Klinefelter's syndrome - 44 + XXY
d. Colour blindness - Y-linked

166. Both sickle cell anemia and Huntington's chorea are: *(2006)*

a. Virus related diseases
b. Bacteria related diseases
c. Congenital disorders
d. Pollution induced disorders

167. Cri-du-chat syndrome in humans is caused by: *(2006)*

a. Trisomy of 21st chromosome
b. Loss of half of short arm of chromosome 5
c. Loss of half of long arm of chromosome 5
d. Fertilisation of an XX egg by a normal Y-bearing sperm

168. Sickle cell anemia has not been eliminated from African population as: *(2006)*

a. It is controlled by dominant genes
b. It is controlled by recessive genes
c. It is not a fatal disease
d. It provides immunity against malaria

169. A woman with 47 chromosomes due to presence of additional 21 chromosomes is characterised by: *(2005)*

a. Super femaleness b. Turner's syndrome
c. Down's syndrome d. Triploidy

170. A woman with normal vision but with colorblind father marries a colorblind man. The fourth child of the couple is a boy. This boy: *(2005)*

a. May or may not be colorblind
b. Must be colorblind
c. Must have normal vision
d. Will be partially colorblind due to being heterozygous

171. Which one is not a hereditary disease? *(2005)*

a. Cystic fibrosis b. Cretinism
c. Thalassemia d. Hemophilia

172. A normal couple has seven children (2 daughters and 5 sons). There of the sons suffer from a hereditary disorder but none of the daughters is affected. Which is the inheritance type? *(2005)*

a. Sex-limited recessive b. Autosomal dominant
c. Sex-linked dominant d. Sex-linked recessive

173. A normal woman, whose father was colour-blind is married to a normal man. The sons would be: *(2004)*

a. 50% colour-blind b. All normal
c. All colour-blind d. 75% colour-blind

174. A male human is heterozygous for autosomal genes A and B and is also hemizygous for hemophilic gene h. What proportion of his sperms will be AB^{h}? *(2004)*

a. $\frac{1}{32}$ b. $\frac{1}{16}$
c. $\frac{1}{4}$ d. $\frac{1}{8}$

175. Down's syndrome is caused by an extra copy of chromosome number 21. What percentage of offspring produced by an affected mother and a normal father would be affected by this disorder? *(2003)*

a. 100% b. 75%
c. 50% d. 25%

176. Pattern baldness, moustaches and beard in human males are examples of: *(2003)*

a. Sex linked traits b. Sex limited traits
c. Sex differentiating traits d. Sex-determining traits

177. Genes for cytoplasmic male sterility in plants are generally located in: *(2003)*

a. Chloroplast genome b. Mitochondrial genome
c. Nuclear genome d. Cytosol

178. Which of the following is correct match? *(2002)*

a. Down Syndrome - 21st Chromosome
b. Sickle cell anaemia- X -Chromosome
c. Haemophilia - Y - Chromosome
d. Parkinson Disease - X & Y Chromosome

179. Which of the following is the example of sex linked disease? *(2002)*

a. AIDS b. Colour blindness
c. Syphilis d. Gonorrhoea

180. A diseased man marries a normal woman. They get three daughter and five sons. All the daughter were diseased and sons were normal. The gene of this disease is: *(2002)*

a. Sex linked dominant b. Sex linked recessive
c. Sex limited character d. Autosomal dominant

181. Probability of four son to a couple is: *(2001)*

a. $\frac{1}{4}$ b. $\frac{1}{8}$
c. $\frac{1}{16}$ d. $\frac{1}{32}$

182. Sickle cell anaemia is due to: *(2001)*

a. Change of amino acid in α - chain of haemoglobin
b. Change of amino acid in β - chain of haemoglobin
c. Change of amino acid in both α and β chain of haemoglobin
d. Change of amino acid either α or β chain of haemoglobin

183. Mongolian idiots are due to trisomy in 21st chromo-some is called: *(2000)*

a. Down's syndrome b. Turner's syndrome
c. Kleinfelter's syndrome d. Triplex syndrome

184. In *Drosophila*, the XXY condition leads to female-ness whereas in human beings the same condition leads to Klinefelter's syndrome in male. It proves: *(2000)*

a. In human beings, Y chromosome is active in sex determination
b. Y chromosome is active in sex determination in both human beings and *Drosophila*
c. In *Drosophila*, Y chromosome decides femaleness
d. Y chromosome of man have genes for syndrome

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185. What ratio is expected in offsprings if father is colour blind and mother's father was colour blind? *(1999)*
a. 50% daughter - colour blind
b. All the sons are colour blind
c. All the daughters are colour blind
d. All the sons are normal

186. Fraternal twin one baby is haemophilic while baby's brother is normal then which statement is true? *(1999)*
a. Baby is male b. Baby is female
c. Mother is heterozygous d. Mother is homozygous

187. If a female having gene for haemophilia and colour-blindness on its one X-chromosome marries a normal male then what are the chances in their offsprings? [MR^A] *(1998)*
a. 50% son diseased and 50% normal
b. All normal offsprings
c. 100% daughters are carrier
d. 100% son diseased

188. First child of a normal male and female is albino, what are the chances of second child to be albino? *(1998)*
a. 25% b. 50%
c. 75% d. 100%

189. Reason for trisomy in down's syndrome: *(1998)*
a. Non-disjuction during sperm formation
b. Non-disjunction during egg formation
c. Non-disjunction at the time of egg or sperm formation
d. Addition of one extra chromosome during mitosis

190. Mental retardness in man occur due to: *(1998)*
a. Loss of one X chromosome
b. Addition of one X chromosome
c. Slight growth in Y
d. Overgrowth in Y

191. A person with the sex chromosomes XXY suffers from: *(1997)*
a. Gynandromorphism b. Klinefelter's Syndrome
c. Down's syndrome d. Turner's syndrome

192. In which of the following diseases, the man has an extra X-chromosome? *(1996)*
a. Turner's syndrome b. Klinefelter's syndrome
c. Down's syndrome d. Haemophilia

193. A person whose father is colour blind marries a lady whose mother is daughter of a colour blind man. Their children will be: *(1996)*
a. All sons colour blind
b. Some sons normal and some colour blind
c. All colour blind
d. All daughters normal

194. A genetically diseased father (male) marries with a normal female and gives birth to 3 carrier girls and 5 normal sons. It may be which type of genetic disease? *(1996)*
a. Sex-influenced disease
b. Blood group inheritance disease
c. Sex-linked disease
d. Sex-recessive disease

195. An abnormal human male phenotype involving an extra X-chromosome (XXY) is a case of: *(1995)*
a. Edward's syndrome b. Klinefelter's syndrome
c. Intersex d. Down's syndrome

196. When an animal has both the characters of male and female, it is called: [OS] *(1994)*
a. Super female b. Super male
c. Intersex d. Gynandromorph

197. Albinism is a congenital disorder resulting from the lack of which enzyme? *(1994)*
a. Tyrosinase b. Xanthine oxidase
c. Catalase d. Fructokinase

198. The colour blindness is more likely to occur in males than in females because: *(1994)*
a. The Y-chromosome of males have the genes for distinguishing colours
b. Genes for characters are located on the sex-chromosomes
c. The trait is dominant in males and recessive in females
d. None of the above

199. Of both normal parents, the chance of a male child becoming colour blind are: *(1993)*
a. No
b. Possible only when all the four grandparents had normal vision
c. Possible only when father's mother was colour blind
d. Possible only when mother's father was colour blind

200. Of a normal couple, half the sons are haemophiliac while half the daughters are carriers. The gene is located on: *(1993)*
a. X-chromosome of father
b. Y-chromosome of father
c. One X-chromosome of mother
d. Both the X-chromosomes of mother

201. When a certain character is inherited only through female parent, it probably represents: *(1992)*
a. Multiple plastid inheritance
b. Cytoplasmic inheritance
c. Incomplete dominance
d. Mendelian nuclear inheritance

202. A colour blind mother and normal father would have: *(1992)*
a. Colour blind sons and normal/carrier daughters
b. Colour blind sons and daughters
c. All colour blind
d. All normal

203. Down's syndrome is due to: *(1992)*
a. Crossing over
b. Linkage
c. Sex-linked inheritance
d. Nondisjunction of chromosomes

204. In human beings, 45 chromosomes/ single X/XO abnormality causes: *(1992)*
a. Down's syndrome b. Klinefelter's syndrome
c. Turner's syndrome d. Edward's syndrome

205. A colour blind girl is rare because she will be born only when: *(1991)*
a. Her mother and maternal grand father were colour blind
b. Her father and maternal grand father were colour blind
c. Her mother is colour blind and father has normal vision
d. Parents have normal vision but grandparents were colour blind

206. In Down's syndrome of a male child, the sex complement is: *(1990)*
a. XO b. XY
c. XX d. XXY

207. Haemophilia is more common in males because it is a: *(1990)*
a. Recessive character carried by Y-chromosome
b. Dominant character carried by Y-chromosome
c. Dominant trait carried by X-chromosome
d. Recessive trait carried by X-chromosome

208. Which one is a hereditary disease? *(1990)*
a. Cataract b. Leprosy
c. Blindness d. Phenylketonuria

209. Both husband and wife have normal vision though their fathers were colour blind. The probability of their daughter becoming colour blind is: *(1990)*
a. 0% b. 25%
c. 50% d. 75%

210. A normal green male is crossed with albino female. The progeny is albino because: *(1989)*
a. Trait for a albinism is dominant
b. The albinos have biochemical to destroy plastids derived from green male
c. Plastids are inherited from female parent
d. Green plastids of male must have mutated

Answer Key

1. (b)	2. (b)	3. (b)	4. (b)	5. (b)	6. (c)	7. (d)	8. (b)	9. (b)	10. (c)
11. (a)	12. (a)	13. (c)	14. (a)	15. (b)	16. (a)	17. (a)	18. (a)	19. (c)	20. (a)
21. (b)	22. (a)	23. (a)	24. (a)	25. (a)	26. (b)	27. (b)	28. (b)	29. (b)	30. (c)
31. (b)	32. (b)	33. (b)	34. (d)	35. (b)	36. (c)	37. (d)	38. (a)	39. (d)	40. (d)
41. (a)	42. (a)	43. (c)	44. (d)	45. (a)	46. (a)	47. (d)	48. (d)	49. (d)	50. (b)
51. (b)	52. (d)	53. (b)	54. (c)	55. (b)	56. (d)	57. (a)	58. (d)	59. (d)	60. (c)
61. (c)	62. (d)	63. (c)	64. (d)	65. (a)	66. (d)	67. (b)	68. (d)	69. (d)	70. (a)
71. (a)	72. (b)	73. (a)	74. (c)	75. (c)	76. (a)	77. (a)	78. (c)	79. (c)	80. (c)
81. (d)	82. (c)	83. (d)	84. (d)	85. (d)	86. (d)	87. (a)	88. (c)	89. (b)	90. (b)
91. (a)	92. (d)	93. (c)	94. (c)	95. (b)	96. (b)	97. (c)	98. (a)	99. (c)	100. (c)
101. (a)	102. (a)	103. (b)	104. (b)	105. (a)	106. (a)	107. (c)	108. (b)	109. (b)	110. (d)
111. (a)	112. (d)	113. (a)	114. (c)	115. (a)	116. (d)	117. (c)	118. (c)	119. (a)	120. (a)
121. (a)	122. (b)	123. (c)	124. (a)	125. (a)	126. (c)	127. (d)	128. (b)	129. (b)	130. (c)
131. (b)	132. (c)	133. (c)	134. (d)	135. (c)	136. (b)	137. (a)	138. (a)	139. (d)	140. (c)
141. (c)	142. (a)	143. (b)	144. (b)	145. (b)	146. (d)	147. (a)	148. (c)	149. (c)	150. (d)
151. (b)	152. (b)	153. (c)	154. (b)	155. (d)	156. (d)	157. (d)	158. (c)	159. (c)	160. (a)
161. (d)	162. (a)	163. (c)	164. (a)	165. (c)	166. (c)	167. (b)	168. (d)	169. (c)	170. (a)
171. (b)	172. (d)	173. (a)	174. (d)	175. (c)	176. (b)	177. (b)	178. (a)	179. (b)	180. (a)
181. (c)	182. (b)	183. (a)	184. (a)	185. (a)	186. (c)	187. (a)	188. (a)	189. (c)	190. (b)
191. (b)	192. (b)	193. (d)	194. (c)	195. (b)	196. (d)	197. (a)	198. (b)	199. (d)	200. (c)
201. (b)	202. (a)	203. (d)	204. (c)	205. (b)	206. (b)	207. (d)	208. (d)	209. (a)	210. (c)

Explanations

1. (b) 20 produced violet and 20 produced white flowers.

A monohybrid cross between a heterozygous violet flowered pea plant (Vv, where V = violet is dominant) and a homozygous white flowered pea plant (vv) can be predicted using a Punnett square.

Phenotype of parents → Violet flower × White
Genotype → Vv vv
Gametes → (V) (v) (v) (v)
F_1 generation →

♂ / ♀	V	v
v	Vv	vv
v	Vv	vv

Among 40 progenies, the cross would result in:

20 progenies (50% Vv : violet flowers)

20 progenies (50% vv; white flowers)

2. (b) Gregor Mendel conducted hybridisation experiments on garden peas for seven years (1856-1863) and proposed the laws of inheritance in living organisms. Characters examined by Mendel were seed shape, seed colour, flower colour, pod shape, pod colour, flower position and stem height.

3. (b) The production of gametes by the parents, formation of zygotes, the F_1 and F_2 plants, can be understood by diagram known as Punnett square. It was developed by a British geneticist, Reginald C. Punnett. It is a graphical representation to calculate the probability of all possible genotypes of offspring in a genetic cross.

4. (b) ABO blood groups are controlled by the gene *I*. The gene *I* has three alleles I^A, I^B and *i*. The alleles I^A and I^B produce a slightly different form of the sugar while allele *i* does not produce any sugar. Because humans are diploid organisms, each person possess any two of the three '*I*' gene alleles. I^A and I^B are completely dominant over I^O, but when I^A and I^B are present together, they both express their own types of sugar, thus, behaving as codominant alleles.

5. (b) Mendel selected 14 true breeding plant varieties.

6. (c) 7 contrasting characters were studied by Mendel for his experiments. Some of the contrasting traits selected were smooth or wrinkled seeds, yellow or green seeds, inflated (full) or constricted green or yellow pods and tall or dwarf plants.

7. (d) Genes for flower colour in snapdragon shows incomplete dominance which is an exception of Mendel's first principle, *i.e.*, law of dominance. Here, the F_1 had a phenotype that did not resemble either of the two parents and was in between the two. Law of segregation is universally applicable.

8. (b) Blood group represent – dominance, co-dominance and multiple alleles. Three alleles (I^A, I^B, I^O) determine the characteristic, i.e., blood group I^A and I^B are dominant over I^O; I^A and I^B are co-dominant with each other.

9. (b)

Characters	Dominant	Recessive
1. Stem height	Tall	Dwarf
2. Flower colour	Violet	White
3. Flower position	Axial	Terminal
4. Pod shape	Inflated	Constricted
5. Pod colour	Green	Yellow
6. Seed shape	Round	Wrinkled
7. Seed colour	Yellow	Green

10. (c) Husband × Wife
I^AI^B I^Bi

♂ / ♀	I^A	I^B
I^B	I^AI^B	I^BI^B
i	I^Ai	I^Bi

Number of genotypes = 4
Number of phenotypes = 3
I^AI^B and I^Bi = A
I^AI^B = AB
I^Bi = B

11. (a) Mendel conducted hybridisation experiments on the plant for 7 years between 1856 to 1863 and his data published in 1865.

12. (a) A true breeding line is one that have undergone continuous self-pollination, shows the stable trait inheritance and expression for several generations.

13. (c) T.H. Morgan attributed the physical association or linkage of the two genes and coined the term linkage. If parental type combination are more produced then recombinant type then the genes are said to be linked.

14. (a) A phenotypic ratio of 3/4th tall : (1/4 TT + 1/2 Tt or 1/4th tt, i.e., 3:1 ratio, but a genotypic ratio of 1:2:1.

15. (b) Mendel conducted hybridisation experiments on garden pea. Mendel investigated seven pair of contrasting characters. These were Seed shape, Seed colour, Flower colour, Pod Shape, Pod colour, Flower position and Stem height.

16. (a) Man I^Bi, woman I^Bi

	I^B	i
I^B	I^BI^B	I^Bi
i	I^Bi	ii

17. (a) When there are more than two alternate forms of a gene present on the same locus are called multiple alleles. There is absence of crossing over in multiple alleles.

18. (a) Term allele was given by W. Bateson. Alleles are different molecular forms of a gene.

19. (c) The alleles which do not show dominance - recessive relationship and are able to express themselves independently and equally when present together.

20. (a) Mendel conducted hybridisation experiments on garden pea. Mendel investigated seven characters that were manifested as two opposite traits.

Eg., seed shape, seed colour, flower colour, pod shape, flower position and stem height.

21. (b)

I^AI^A, I^BI^B → AB } Co-dominance

22. (a) In case of co-dominance, F_2 generation resembles both parents. e.g., ABO blood grouping in humans.

23. (a) Test cross is done to determine the genotype of unknown tall plant is either homozygous or heterozygous.

24. (a) F_2 generation in a Mendelian cross showed that both genotypic and phenotypic ratios are same as 1 : 2 : 1. It represents a case of monohybrid cross with incomplete dominance.

In incomplete dominance, the F_1 phenotype does not resemble either of the two parents and is in between the two.

25. (a) Test cross is a cross done either to know the genotype of F_1 generation or to understand the linkage between the genes.

This cross is performed by crossing F_1 progeny with recessive parent plant. E.g., Tt × tt / Tt Rr × tt

26. (b)

RR (Red) × rr (White)
↓
Rr
↓
F_1 — (Pink)

F_2: $F_1 \times F_1$
Rr × Rr
RR : Rr : rr
1 : 2 : 1
Genotype of the parent = Rr

27. (b) Alleles do not show any blending and both characters recover as such in F_2 generation is explained by law of segregation.

28. (b) Test cross is the way of determining the genotype of dominant individual.

29. (b) Number of phenotypes in ABO blood group are 4 (A, B, AB and O)

30. (c) Test cross involves F_1 x homozygous recessive parent

31. (b) Test cross is performed to know the genotype of an unknown individual. In test cross, F_1 generation crossed with homozygous recessive parent.

32. (b) In AB blood group, individual has RBCs with both A & B - type of antigens, whereas plasma has no antibodies. Therefore, they are also known as universal acceptor.

33. (b) Reciprocal crosses are crosses between two individuals where the sexes of parents are reversed.

It is designed to test the role of parental sex on a given inheritance pattern.

34. (d) Pea has 7 pairs of chromosomes, although 7 characteristics that Mendel studied were located on 5 different chromosomes.

35. (b) Yellow seed colour was the dominant trait of garden pea.

36. (c) Recessive genes express itself only in homozygous condition while dominant genes are expressed in both homozygous & heterozygous condition.

37. (d) Wrinkled seeds have reverse taste caused by higher level of sugars, this trait is due to disruption in the biochemical process responsible for making starch in the peas. Scientists found that the gene for starch-processing enzyme is wrinkled seeds contain an extra piece of DNA that stops gene from functioning & enzymes are not produced.

38. (a) Alleles of a gene pair in a heterozygote are fully expressed, i.e., dominant or recessive, both alleles express themselves in offspring and result in a phenotype neither dominant nor recessive. E.g., ABO blood group.

39. (d) Round & yellow seeds, violet flowers, full and green pod, axially positioned flower & tall plants were dominant traits of Mendelian characters.

40. (d) Law of Dominance (given by Mendel) states that allele of a gene is dominant over other allele of same gene and is thus expressed in F_1 generation.

41. (a) In ABO blood group system, alleles I^A & I^B are codominant that is they are fully expressed in heterozygous condition and allele *i* is recessive, i.e., if present, with 'I^A' or 'I^B', will not influence the expression of alleles I^A & I^B.

42. (a) Genes located on the same locus of chromosomes are called multiple alleles. They are produced due to repeated mutations of the same gene but in different directions. Multiple alleles being located on the same locus do not show crossing over.

(c) Pseudoalleles are closely linked genes on a chromosome that appear to function as a single allelic pair.

43. (d) The child of O-group has B-group father. The genotype of father will be I^BI^O. The genotype of the child would be I^OI^O (recessive). Hence, the genotype of the father can only be I^BI^O.

45. (a) An allele is dominant if it is expressed itself in the heterozygous as well as heterozygous condition.

46. (a) During segregation, paired homologous chromosomes separate from each other and migrate to opposite poles of nucleus. It occurs during Anaphase I.

47. (d) An individual having two of the same alleles, whether dominant or recessive, they are called homozygous. Heterozygous means having one each of two different alleles.

48. (d) $I^AI^A \times I^AI^B$ gives us the following genotypes I^AI^A, I^AI^B, I^AI^B. Hence, when a man of blood group A marries a women of AB blood group, B progeny would indicate that man is heterozygous A.

49. (d) Blood group is controlled by more than two alleles which are I^A, I^B and I^o. I^A & I^B are codominant and I^o is recessive allele.

50. (b) Allelomorphs are either of a pair of alternative forms of a gene that can occupy the same locus on a particular chromosome. It is a synonym for term 'allele'.

51. (b) Gregor Johann Mendel, discovered the fundamental laws of inheritance, is known as the father of genetics.

52. (d) The allele which is unable to express its effect in the presence of another is called recessive. A member of a pair of alleles that does not show its effect in the phenotype in the presence of any other allele. It is denoted by small letter.

53. (b) In incomplete dominance, one allele for a specific trait is not completely expressed over its paired allele and thus heterozygous condition result in intermediate phenotype.

54. (c) Multiple allelism is determination of one phenotype by more than two alleles. In blood group system of human beings, three alleles control one phenotype (which is blood group).

55. (b) Parents : Tt × tt

offsprings : Tt Tt tt tt

50% heterozygous 50% recessive

56. (d) Mendel considered one character at a time that helped him to clearly formulate his laws of inheritance.

57. (a) Monohybrid cross - 3 : 1

Dihybrid cross - 9 : 3 : 3 : 1

Incomplete dominance - 1 : 2 : 1

Test Cross - 1 : 1

58. (d) 6

Seed colour: Yellow (Y) is dominant over green (y).

Flower colour: Exhibits incomplete dominance, where red (R) and white (r) alleles result in pink (Rr) when heterozygous.

The F_1 generation, resulting from the cross of YYRR (yellow seeds, red flowers) and yyrr (green seeds, white flowers), would all be YyRr (yellow seeds, pink flowers).

On selfing F_1 generation, 6 phenotypes can be observed:

	YR	yR	Yr	yr
YR	YYRR (Yellow Red)	YyRR (Yellow Red)	YYRr (Yellow Pink)	YyRr (Yellow Pink)
yR	YyRR (Yellow Red)	yyRR (Green Red)	YyRr (Yellow Pink)	yyRr (Green Pink)
Yr	YYRr (Yellow Pink)	YyRr (Yellow Pink)	YYrr (Yellow White)	Yyrr (Yellow White)
yr	YyRr (Yellow Pink)	yyRr (Green Pink)	Yyrr (Yellow White)	yyrr (Green White)

59. (d)

GGII (Green, Inflated) × ggii (Yellow, Constricted)

GI gi

GgIi (Green, Inflated)

Self fertilisation

	GI	Gi	gI	gi
GI	GGII Green, Inflated	GGIi Green, Inflated	GgII Green, Inflated	GgIi Green, Inflated
Gi	GGIi Green, Inflated	GGii Green, Constricted	GgIi Green, Inflated	Ggii Green, Constricted
gI	GgII Green, Inflated	GgIi Green, Inflated	ggII Yellow, Inflated	ggIi Yellow, inflated
gi	GgIi Green, Inflated	Ggii Green, Constricted	ggIi Yellow, Inflated	ggii Yellow, Constricted

F_2 phenotypic ratio - 9 : 3 : 3 : 1

9 – Green, inflated : 3 – Green, constricted : 3 – Yellow, inflated : 1 – Yellow, constricted

Since, yellow and inflated pod (recombinants) are 3/16- 18.75%.

60. (c) Fruit colour in squash is an example of dominant epistasis.

61. (c) Tightly linked genes do not follow the law of independent assortment hence show very less percentage of recombination.

62. (d) Yellow seed = YY

Green seed = yy

Heterozygous yellow crossed with green seeded.

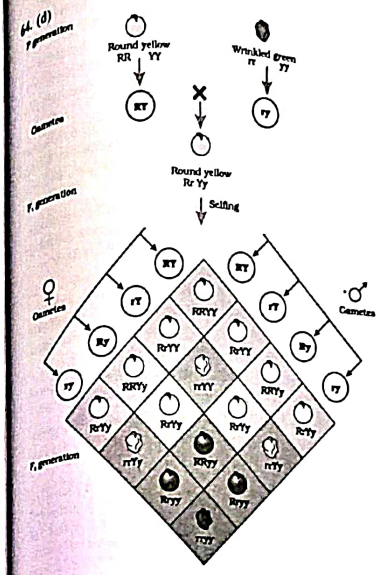
Yy × yy

Yy Yy yy yy

50% yellow seed 50% green seed

63. (c) Genotype of hybrid is obtained by test cross. It is done by crossing F_1 with recessive parent.

64. (d)



65. (a) RR Tt × rr tt

Gametes : RT Rt rt

Offsprings: RrTt and Rrtt

(red & tall) (red & dwarf)

50% of offsprings will be red & tall, and

50% of offsprings will be red & dwarf

66. (d) In a trihybrid plant, there are 3 contrasting characters. For self fertilisation: no. of gametes = 2^n (n is no. of contrasting characters).

So, no. of gametes = $2^3 = 8$ gametes

And, no. of zygotes = $4^3 = 64$ different zygotes will be formed.

67. (b) When genes are closely linked then they cannot be assorted independently to the gametes.

68. (d) Epistatic interaction in which both genes are required for a correct function, is called complementary gene interaction. This interaction modify the 9:3:3:1 phenotypic ratio to 9:7. As in heterozygous condition, the phenotype (or function) will not be expressed.

69. (d) In complementary gene interaction, both genes are required to express a particular phenotype. If either of them is absent then phenotype will not be produced.

70. (a) Cross TTRr × ttrr

Gametes : TR Tr tr

Progeny : TtRr (Tall red) Ttrr (Tall white)

50% of progeny will have red flowers and all of the progenies will be tall so 50% plants are tall & red flowered.

71. (a) If pea plant would have 12 chromosomes then the pair of alleles of a gene would be closely associated and Mendel might have not observed independent assortment.

72. (b) Complementary genes are mutant alleles at different loci which complement one another to give a wild-type phenotype.

73. (a) Epistasis is the term that refers to the action of one gene upon another.

74. (c) AABB × aabb

Gametes : AB ab

F_1 : AaBb × AaBb

Gametes : AB Ab aB ab

F_2	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

Phenotype ⇒ AABB : AaBB : Aabb : aabb

Ratio ⇒ 1 : 2 : 2 : 1

75. (c) Mendel deduced three laws of inheritance which are - law of dominance, law of segregation & law of independent assortment.

76. (a) Let A is the allele for brown colour, and a is the allele for blue colour

aa (Blue-eyed mother)

Parents: aa (Blue-eyed woman) × Aa (Brown-eyed man)

Gametes: a A & a

Progeny: Aa (Brown eye) aa (Blue eye)

Phenotypic ratio ⇒ 1 (Brown eye) : 1 (Blue eye)

77. (a) Cross between AaBB and aaBB will form 1 AaBB : 1 aaBB. On crossing, AaBB x aaBB gives 50% individuals having genotype AaBB and 50% individuals having genotype aaBB.

78. (c) When recessive allele of one gene masks the effects of either allele of second gene, then interaction is called recessive epistasis. Phenotypic ratio are 9 : 3 : 4 in F_2.

79. **(c)** The chromosomal theory of inheritance was proposed by Sutton and Boveri, who linked chromosomal segregation with Mendelian principles, identifying chromosomes as carriers of genetic factors.

80. **(c)** The experimental verification of the chromosomal theory of inheritance was done by Thomas Hunt Morgan and his colleagues. Morgan worked with the tiny fruit flies, *Drosophila melanogaster* and led to discovering the basis for the variation that sexual reproduction produced. Laws of inheritance were given by Mendel. Sutton and Boveri proposed the chromosomal theory of inheritance.

81. **(d)** The chromosomal theory of inheritance was proposed by Sutton and Boveri in 1903. Sutton and Boveri argued that the pairing and separation of a pair of chromosomes would lead to the segregation of a pair of factors they carried. Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it the chromosomal theory of inheritance.

82. **(c)** 1 map unit is equivalent to 1% cross over. Map unit is used to measure genetic distance. This genetic distance is based on average number of cross over frequency.

83. **(d)** *Drosophila melanogaster* commonly called fruit fly. It often used in genetic and developmental biology research. The ripe banana is the most suitable for the culture of this fly.

84. **(d)** Generally effect of a gene can be seen on a single phenotype of a trait. However, there are instances where a single gene can exhibit multiple phenotype expression. Such a gene is called a pleiotropic gene.

85. **(d)** Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on ie chromosome.

1) Mendel's laws were extended in the form of 'Chromosomal heory of Inheritance'. Later, it was found that Mendel's law f independent assortment does not hold true for the genes iat were located on the same chromosomes. These genes vere called as 'linked genes'. Closely located genes assorted ogether, and distantly located genes, due to recombination, ssorted independently.

(a) When a single gene can exhibit multiple phenotypic expression. Such a gene is called a pleiotropic gene. An example of this is the disease phenylketonuria, which occurs in humans. The disease is caused by mutation in the gene that codes for the enzyme phenylalanine hydroxylase (single gene mutation).

88. **(c)** Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes.

89. **(b)** Reignald C. Punnett, British geneticist, devised the Punnett square in early 1900s.

90. **(b)** A-(ii), B-(iii), C-(iv), D-(i)

91. **(a)** When a portion of chromosomes breaks and attached to another is known as translocation.

92. **(d)** The term linkage was given by T. H. Morgan. He discovered this phenomenon while working on fruit flies

93. **(c)** When a gene affects many aspects of phenotype, i.e. controls several phenotypes, it is said to be pleiotropic gene

94. **(c)** Tightly linked genes show 100% parental types and (0% recombinants

95. **(b)** Phenotype is determined by its genes, the dominance relationships between alleles and by the interaction during development between the genetic constitution and the environment.

96. **(b)** If two genes are closed together on the same chromosome, they do not assort independently during gamete formation and are called linked genes. This idea is called linkage.

97. **(c)** Recombination frequency maxes out at 50% distance between both genes are 66 centimorgan or map units, i.e., both genes are loosely packed. Hence, the individuals with parental type would be > 50% & recombinant individuals (flies with recombinant y & b genes) will be < 50%.

98. **(a)** Gene map describes the spatial arrangement of genes on a chromosome.

99. **(c)** Genes which are closely linked often inherited together. There is very rare chances of crossing over between them and thus are not independently assorted.

100. **(c)** A gene that influences two or more unrelated phenotypic traits is called pleiotropic gene. Any mutation in pleiotropic gene effects several traits simultaneously. e.g, sickle cell anaemia in which mutation of Hb gene leads to anemia, damage to various internal organs including spleen & heart and bossed skull.

101. **(a)** Frequency of crossing over between genes 'b' & 'c' is maximum, i.e., 28% , therefore they are located at the ends

and the gene map will look like : b ←20%→ a ←8%→ c, with 28% between b and c

102. **(a)** F_1 : AABbCC × AABbCC

↓

F_2: AABBCC AABbCC AAbBCC AAbbCC

Genotypic ratio ⇒ 1 : 2 : 1

AABBCC AABbCC AAbbCC

Phenotypic ratio ⇒ 3 : 1

103. **(b)** A & B genes are linked, i.e., there would be no independent assortment in them & gametes formed will be either AB or ab. So,

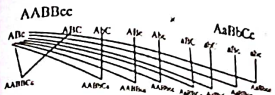
Parents : AB/ab ab/ab

Gametes: AB & ab ab

AB/ab ab/ab

Genotype would be AaBb & aabb

104. **(b)** Homeotic genes regulate the development of anatomical structures in organisms during early embryonic development. So, when homeotic genes are inactivated due to mutations, they may cause body segments to take on new identities in fruit flies.

105. **(a)** Gametes: AABBCc × AaBbCc

One out of eight progeny is hybrid of 3 genes; so ratio will be 1/8.

106. **(a)** AABbCc

These 4 types of gametes can be formed from AABbCc.

107. **(c)** We can get a spectrum of slightly different phenotypes with polygenic genes.

108. **(b)** To see that whether 'A' & 'B' genes are linked, experiment should consider the cross between AABB & aabb. If A & B will not be assorted independently and if heterozygous do not form in first generation, then A & B are linked genes.

109. **(b)** Independent assortment is true for genes that are located on different chromosome or at a considerable difference on same chromosome. If genes are closely placed on a chromosome such that they are assorted together, then this condition is called linkage which Mendel might not have studied.

110. **(d)** Recombination frequency provides an estimate of physical distance. A pair of genes with a larger recombination frequency are likely farther apart. Recombination frequency maxes out at 50%. These non allelic genes are 50 map units apart, i.e., the distance is maximum & thus linkage is absent.

111. **(a)** Polygenic inheritance occurs when one characteristic is controlled by two or more genes, e.g., skin colour in humans, height, weight & eye colour are other examples.

112. **(d)** Bateson and Punnett explained that when two dominants enter from the same parent they try to remain together, called coupling. When two dominants enter from different parents they try to remain separate called repulsion. Bateson and Punnett *(1906)* used the term coupling and repulsion in sweet pea (*Lathyrus odoratus*) for linkage and crossing over. The correct parental of coupling type along with its cross over or repulsion is coupling AABB, aabb : Repulsion AAbb; aaBB.

113. **(a)** (B) and (D) only

In grasshoppers, sex determination is an example of male heterogamety, not female heterogamety. Males produce two different types of gametes concerning the sex chromosomes. Grasshopper is an example of XO type of sex determination in which the males have only one X-chromosome besides the autosomes, whereas females have a pair of X-chromosomes. All eggs bear an additional X chromosome besides the autosomes.

114. **(c)** In bird females, heterogamety is found, i.e., a female bird has two sex chromosomes, Z and W and can produce two different types of gametes. Thus sex of progeny depends on the types of egg rather than the type of sperm.

115. **(a)** Starch synthesis in pea plants is controlled by a single gene, which has two alleles- one dominant and other recessive.

116. **(d)** Abnormal ova is formed in mother's ovary due to non-disjunction of X-chromosome in the mother.

117. **(c)** Grasshopper is an example of XO type of sex determination in which the males have only one X-chromosome besides the autosomes, whereas females have a pair of X-chromosomes. X/A determine the male character in *Drosophila*.

118. **(c)** If zygote contains XX chromosomes then zygotic cell would lead to the birth of a normal human female child. Karyotype of normal human female is 44A + XX.

119. **(a)** The genotype AaBb produce four different types of diallelic sperms, i.e., AB, aB, Ab, ab.

120. **(a)** Mitochondrial DNA is inherited solely from the mother, father only contributes to chromosomal DNA.

121. **(a)** *Drosophila* has both X & Y chromosomes, but Y chromosomes does not confer maleness and encodes genes necessary for making sperm. It is actually the ratio of X chromosomes to autosomes which determines the sex in them.

122. **(b)** Persons with XX male syndrome have Y chromosome gene (SRY gene) attached to one of their X chromosome.

People with swyer syndrome (or XY female syndrome) have female external genitalia. In them, SRY gene mutations prevent production of sex-determing region (SRY) Y protein & they do not develop testes.

123. **(c)** Barr bodies are inactivated X-chromosomes. Number of Barr body is equal to one less than the total number of X-chromosome so, female with 4 X-chromosomes will have 3 Barr bodies.

124. **(a)** Kappa particles are found in certain killer strains of *Paramoecium* and are responsible for the cytoplasmic inheritance.

125. **(a)** Genetic identity of human male is determined by sex-chromosomes. Y-chromosome has a sex determining region (SRY) that is responsible for male characteristics in humans.

126. **(c)** The female *Drosophila* possesses two homeomorphic sex chromosomes, (XX) and the male *Drosophila* contains two heteromorphic sex chromosomes (XY). The differential or non-homologous region of Y-chromosome is mostly heterochromatic. The female parent produces only one type of eggs (22 + X). The male parent produces two types of gametes (22 + Y) and (22 + X.) They are produced in equal proportions. As the two types of sperms are produced in equal proportions, there are equal chances of getting a male or female fly in a particular mating.

127. **(d)** Barr body is an inactivated X - chromosome found at the periphery of nucleus in somatic cells of females.

128. **(b)** Sickle - cell disease is caused by a single point mutation in the β-globin gene that converts a GAG codon into GUG, which encodes the amino acid valine rather than glutamic acid.

129. **(b)** Genes that are carried on the Y chromosome are called holandric genes. They can only be passed by males onto their sons.

130. **(c)** Genotype of Mr. Kapoor will be BbI hence one fourth of the sperms will have BI

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131. (b) In human beings, sex is determined by sex chromosomes that are carried in nucleus of gametes. If sperm with X chromosome fertilises the egg, then child is female and if sperm with Y chromosome fertilises the egg, then child develops into male.

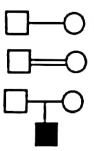
132. (c) Chances of a couple having male child is equal to the chance of having female child. There is 50% probability of each case.

133. (c) Haploids are individuals with one set of chromosomes, i.e., they have only one allele for each gene and thus there is no dominance on any gene to suppress the effect of its recessive counterparts.

134. (d) Klinefelter's Syndrome is a genetic disorder that also caused due to the presence of an additional copy of X chromosome resulting into a karyotype of 47, XXY. Such an individual has overall masculine development, however, the feminine development (development of breast, i.e., Gynaecomastia) is also expressed. Such individuals are sterile.

Down syndrome was first described by Langdon down (1866). In this disorder affected individual is physically, psychomotorly and mentally retarded.

135. (c) ■ ● ◆ Affected individuals



Mating

Mating between relatives (consanguineous mating)

Parents with male child affected with disease

136. (b) Down's Syndrome : The cause of this genetic disorder is the presence of an additional copy of the chromosome number 21 (trisomy of 21). This disorder was first described by Langdon Down (1866). The affected individual is short statured with small round head, furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded.

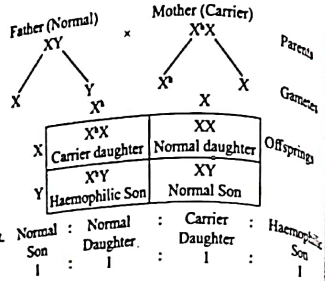
137. (a) Sickle cell disease and haemophilia are genetic blood disorders, the former being autosomal recessive with sickle-shaped cells impairing oxygen delivery, and the latter X-linked recessive affecting blood clotting.

138. (a) Down syndrome, caused by trisomy of chromosome 21. The affected individual is short statured with small round head, furrowed tongue, partially open mouth and broad palm. Physical, psychomotor and mental development is retarded.

139. (d) - Consanguineous mating

(Mating between relatives)

140. (c) The correct phenotypes considering the mother is a carrier for haemophilia (X-linked recessive condition) and the father is normal, would result in haemophilic sons (if they inherit the affected X chromosome from the mother) and carrier daughters or Normal daughter and normal son.



141. (c) Thalassemia and sickle cell anaemia are autosome linked recessive traits while haemophilia is sex linked recessive disease. Myotonic dystrophy is an autosomal dominant trait.

142. (a) Genotype of colour blind female (mother) → X^cX^c ...(i)

If the mother of the man (father) was colour blind then the man will also be colour blind and his genotype will be X^cY ...(ii)

Cross between (i) and (ii)

	X^c	Y
X^c	X^cX^c	X^cY
X^c	X^cX^c	X^cY

Here, we can see that all the offsprings are affected. Therefore, 100% progeny will be colour blind.

143. (b) According to given question

$Hb^AHb^s \times Hb^AHb^s$ Parents

↓

Hb^AHb^A Hb^AHb^s Hb^AHb^s Hb^sHb^s Offsprings

Unaffected Carrier Carrier Diseased

Total number of affected progenies = 1

∴ Percentage of diseased/affected progenies

$= \frac{1}{4} \times 100 = 25\%$

144. (b) Phenylketonuria, thalassemia and sickle cell anaemia are autosomal recessive disorder. Haemophilia is X-linked recessive disorder.

145. (b) Individuals with Klinefelter's syndrome have an additional copy of X-chromosome resulting into a karyotype of 44 + XXY (47). They show overall masculine development, gynaecomastia and are sterile.

146. (d) Women has only X-chromosome with her which she can pass to any child-boy or girl. In contrast, a man can pass X-chromosome to only his daughter and Y-chromosome to only his son.

147. (a) Down's syndrome (Mongolism): It is the presence of an additional copy of chromosome number 21 (trisomy of 21)

Genetic constitution: 45 A + XX or 45 A + XY (i.e., 45 chromosomes).

Features:

- They are short statured with small round head.
- Broad flat face.
- Furrowed big tongue and partially open mouth.
- Many "loops" on finger tips.
- Palm is broad with characteristic palm crease.
- Retarded physical, psychomotor and mental development.
- Congenital heart disease.

148. (c) Thalassemia differs from sickle-cell anaemia in that the former is a quantitative problem of synthesising too few globin molecules while the latter is a qualitative problem of synthesising an incorrectly functioning globin.

149. (c) When a colour blind man (X^cY) marries a woman with normal sight (XX) who has no family history of colour blindness, all of their sons will be normal and all of their daughters will be carriers as shown below:

Parents: Normal woman (XX) × colour blind man (X^cY)

Progeny:

♀ / ♂	X^c	Y
X	XX^c	XY
X	XX^c	XY

All carrier daughters — All normal son

150. (d) Sickle cell anaemia is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carrier for the gene (or heterozygous).

151. (b) Hemophilia is X-linked recessive disease, which shows its transmission from unaffected carrier female to some of the male progeny; has been widely studied. The family pedigree of Queen Victoria shows a number of hemophiliac descendant's as she was a carrier of the disease.

152. (b) Autosomal recessive trait can be transmitted from parents to the offspring when both the partners are carriers for the gene (or heterozygous).

In generation I, the female is a carrier of the disease and male is affected by the disease. In generation II, the female receives the affected genes from both mother and father.

When II-1 marries a normal male, none of the offsprings are affected by the disease. However, the female of generation III is a carrier of the disease as she received the defective gene from the mother.

As III-6 and III-7 are not affected by the disorder, thus skip generation. This type of inheritance is shown in autosomal recessive disorder.

153. (c) Colorblind man crosses with normal woman:

	X	X
X^c	X^cX	X^cX
Y	XY	XY

X^cX [daughter of colorblind man]

	X	Y
X^c	X^cX	X^cY
X	XX	XY

XY [son of colorblind man]

	X	X
X	XX	XX
Y	XY	XY

Out of four grandson (X^cY, XY, XY, XY), only one is colorblind.

Probability $= \frac{1}{4} = 0.25$

154. (b) Turner syndrome (45 chromosome) (44 + XO). It has 44 autosomes and 1 sex chromosome.

155. (d) Parents: XY × X^cX

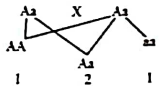
Progeny: X^cX X^cY XX XY

Therefore, 50% of male children of this couple will be colourblind.

156. (d) Haemophilia is an X - linked recessive disorder.

157. (d) Autosomal recessive disorder - Thalassemia.

AA: Normal; Aa: Carrier; aa: affected



Affected child $= \frac{1}{4} = 25\%$

158. (c) The pattern shows that the trait is inherited from mother to son and from father to daughter. This is criss-cross inheritance. Haemophilia is a sex-linked recessive disease, which shows its transmission from unaffected carrier female to some of the male progeny.

159. (c) Colour blindness is an X-Linked disorder. So, woman, whose father was colourblind, will be carrier for the disease.

Parents : Normal man × Carrier woman

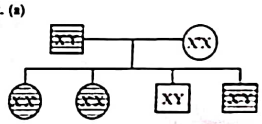
XY X^cY

Progeny:

♀ / ♂	X	Y
X^c	X^cX	X^cY
Y	XY	YY

Thus, the probability of a colorblind daughter (X^cX^c) is zero percent.

160. (a)



161. (d) ○ → unaffected female

□ → unaffected male

□—○ → mating between relatives

◇ → unspecified sex

162. **(a)** Baldness is not a sex-limited trait, but sex-influenced trait.

163. **(c)** Sickle cell anemia is autosomal recessive disorder. In this disease, glutamic acid replaced by valine in β chain of haemoglobin.

164. **(a)** In the first generation, 1 male and 1 female is affected. In the second generation, only male is affected but females are normal, this means that their mother is a carrier for the disease. Thus, it is an autosomal recessive disorder.

165. **(c)** Erythroblastosis foetalis → Rh factor dependent disease

Colour blindness → X linked

Down syndrome → 45 + XY / XX

↓

[trisomy of 21st]

166. **(c)** Both sickle cell anemia and Huntington's chorea are congenital genetic disorders.

167. **(b)** Cri-du-chat syndrome is caused by the deletion of short arm of chromosome number 5. The affected new born cries like mewing of cat.

168. **(d)** Sickle cell anemia provides immunity against malaria. People who are heterozygous for sickle cell allele are much less susceptible for *falciparum* malaria thus; sickle cell allele is maintained at high levels in populations where *falciparum* is common.

169. **(c)** Down syndrome is caused due to trisomy of 21st chromosome; affected individual is short stature, furrow tongue and partially opened mouth.

(a) Woman with normal vision has colorblind father. First find the genotype of woman

Girl father X^cY XX Girl mother

X^cX X^cX XY XY

Genotype of woman = X^cX

She marries with colorblind man

X^cX × X^cY

X^cX^c	X^cY	X^cX	XY

He may or may not be colorblind (50% chance)

170. **(b)** Cretinism is disease related to thyroid. While rest three are hereditary disease.

172. **(d)** Man Woman

XY × X^dX

XX^d XX X^dY XY

Neither man nor woman shows signs of disease it means woman would be carrier for disease causing gene. It is sex linked recessive disease.

173. **(a)** Colour - blindness is sex-linked recessive order. Father of the woman was colour - blind, i.e., he had genotype X^cY. Woman, therefore, have genotype X^cX; as she is normal. Thus 50% of the sons of woman will carry X - chromosome and will be normal, while rest 50% of the sons will carry X^c chromosome from mother resulting in 50% colour- blind sons.

174. **(d)** The person is heterozygous for autosomal gene A, i.e. half of the sperm will have 'A' gene and half of sperm will have 'a' gene. For the same reason, half proportion of sperm will carry autosomal gene 'B' and rest will carry gene 'b'.

Therefore sperms carrying gene 'AB' will be $=\frac{1}{4}$

Person is hemizygous for allele 'h', i.e., X-chromosome has allele 'h' so, sperms either carries X^h or Y each with half proportion. Therefore sperms carrying gene 'AB' and gene 'X' will be equals to

$=\frac{1}{4}(\text{proportion of gene AB}) \times \frac{1}{2}(\text{proportion of gene } X^h)$

$=\frac{1}{8}$

175. **(c)** The abnormality of trisomy of chromosome 21 usually occurs due to failure of the 21st chromosome to separate during egg or sperm development. 50% of offsprings would be affected by Down syndrome.

176. **(b)** Sex-limited genes are those that are present in both sexes but are expressed in only one sex and remain turned-off in the other. Sex hormones or other physiological differences between males and females effect on expression of these genes.

177. **(b)** Male sterility can be due to nuclear or cytoplasmic gene mutations. Cytoplasmic male sterility is due to plasmogenes located in mitochondrial DNA (mt-DNA).

178. **(a)** Down syndrome is trisomy of chromosome 21. Sickle cell anaemia is autosome linked recessive trait.

Haemophilia is sex-linked (X-linked). Parkinson's disease is autosomal linked.

179. **(b)** Colour blindness is sex - linked recessive disorder that is inherited from one generation to next. AIDS, syphilis & Gonorrhea are sexually transmitted disease.

180. **(a)** Sex linked (X-linked) dominant traits transfer from father to all the daughters. Sons get Y - chromosome from father and X-chromosome from mother, therefore, diseased traits do not transfer from father to sons. But, daughter receive X-chromosomes each from one parent.

181. **(c)** Child can be boy or girl, i.e., 2 options

Number of combinations = $4^2 = 16$

There is only one chance in which all the four children will be boys.

so, probability $=\frac{\text{No. of favourable outcomes}}{\text{Total no. of possible outcomes}}=\frac{1}{16}$

182. **(b)** Sickle cell anaemia is caused by the substitution of Glutamic acid (Glu) by valine (Val) at the sixth position of β - globin chain of haemoglobin which makes the RBCs sickle shaped and prone to rupture.

183. **(a)** Down's syndrome is a chromosomal disorder in which failure of segregation of chromatids during cell division leads to gain of extra copy of chromosome 21 (trisomy of 21).

184. **(a)** In *Drosophila*, sex determination is due to the ratio of X-chromosomes & autosomes, i.e., Y-chromosomes do not contribute to determine sex in *Drosophila* males, but in humans Y - chromosomes involves in sex determination.

185. **(a)** Colour blindness is a sex - linked recessive disorder, i.e., diseased condition is homozygous for mutated allele (say X^c). In this case mother is carrier of disease as she receives one mutated allele from her father,

Parents: X^cY (colour blind father) $X\,X$ (carrier mother)

Gametes: X^c, Y, X^c, X

Progeny: X^cX^c (Colour blind daughter), X^cX (Carrier daughter), X^cY (Colour blind son), XY (Normal son)

186. **(c)** Haemophilia is X - linked recessive disorder. It passes from mother to sons. Haemophilic boy receives X^c allele from mother and normal boy receives X allele from mother, therefore, mother is heterozygous.

187. **(a)** Carrier female (X^cX) marries normal man (XY).

X^cX XY

Gametes: X^c & X X & Y

Progeny: X^cY (Diseased son), X^cX (Carrier daughter), XX (Normal daughter) & XY (Normal son)

188. **(a)** Albinism is inherited in an autosomal recessive pattern. That means both parents carry a mutated allele of pair, i.e., heterozygous.

Parents: $\sigma^{\prime}A^cA$ φA^cA

Gametes: A^c, A, A^c, A

Progeny: A^cA^c (albino), A^cA (carrier), A^cA (carrier), AA (normal)

There is a 25% chance that any of their children will have albinism.

189. **(c)** Down syndrome is trisomy of chromosome 21, i.e., an extra copy of chromosome 21. Lack of segregation of chromatids (non-disjunction) during meiosis of gamete formation is a reason of this trisomy.

190. **(b)** Mental retardation in man is associated with XXY chromosomal abnormality. Klinefelter syndrome is a common cause for mental retardation.

191. **(b)** In Klinefelter syndrome, males have 47 chromosomes with an extra X-chromosome. Primary features of this syndrome are sterility and small testicles.

192. **(b)** In Klinefelter's syndrome, male has an extra copy of X-chromosome that results in sterility, reduced testicles & enlarged breasts.

193. **(d)** In question where the genotype of the other parent is not mentioned then that should be considered as normal.

(i) To find out the genotype of person.

His father is colourblind

∴ genotype = X^cY ...(i)

His mother is normal XX ...(ii)

X^cY x XX

Offsprings X^cX, X^cX, XY, XY

As all sons will be normal therefore the genotype of the person will be XY. ...(iii)

(ii) To find out the genotype of lady

Father's genotype - X^cY ...(iv)

Her mother is daughter of colourblind father and normal mother.

X^cY × XX

X^cX, X^cX, XY, XY

So the mother of lady would be carrier having genotype X^cX ...(v)

Performing cross between (iii) and (v) to find out lady's genotype.

X^cX × XY

X^cX, XX, X^cY, XY

As 50% daughter are carrier and 50% daughter are normal. So the lady can be normal or carrier having genotype XX, X^cX respectively. ...(vi)

Now considering both the genotype of the lady and the genotype of the person, the result would be as follows.

XY × X^cX XY × XX

X^cX, XY, XX, X^cY XX, XX, XY, XY

About cases show that if mother (lady) is carrier then options (a) and (c) are not true. Option (b) is true and option (d) all daughters normal (though phenotypically) is also true. If mother is normal then options (a), (b) and (c) are not true and option (d) is true so from the cases, it is concluded that option (d) is true.

194. **(c)** It is a sex-linked disease. It is a disease which occurs due to gene responsible for determining the character concerned and is carried on a sex chromosome. In humans, this is always X-chromosome, e.g., colourblindness. Here a genetically diseased father (male) marries with a normal female (homozygous). Colourblindness is recessive to normal vision so that the sons produced would be normal, but daughters will be heterozygous (normal phenotype), which means that these daughters will be carriers of this trait.

XY Diseased father XX Normal mother

X^cY X^cX XY XY

Carrier daughters Normal sons

195. **(b)** Klinefelter syndrome is a condition where males have an extra X chromosome resulting in XXY condition. About one of every 500 males has an extra X chromosome, but many don't have any symptoms.

196. **(d)** Gynandromorph - Gyno (female part) + Andro (male) + morph (forms), those organisms that possess the characters of female and male are called gynandromorphs.

197. **(a)** *tyr* gene provides instructions for making tyrosinase enzyme which is located in melanocytes, the cells that produce melanin pigments. Lack of this enzyme leads to lack of melanin pigments and thus albinism occurs.

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198. (b) Colour blindness is X - linked recessive disorder. Since, males have only one copy of X - chromosomes, they are most likely to express the mutant allele of colour blindness on X-chromosomes.

199. (d) If mother's father is colour blind then he will transfer the mutant allele to daughter making her carrier of the disease. Carrier mother will transfer the mutant allele to her son and the male child will be colour blind.

200. (c) Of a normal couple, half the sons are haemophilic while half the daughters are carriers. The gene is located on one X-chromosomes of mother. Cross between a haemophilic carrier female X^cX and normal male would yield 50% of the sons being haemophilic and 50% of the daughter are carriers.

201. (b) It represents cytoplasmic inheritance.

202. (a) Colour blindness is sex-linked disorder and affects males more ofter than females. It is recessive in nature.

Parents : XY X^cX^c

Gametes : X Y X^c X^c

Progeny : X^cX X^cX X^cY X^cY

Carrier daughter — Colour-blind sons

203. (d) Down syndrome is trisomy of chromosome 21, i.e., having one extra chromosome 21. During the formation of gametes, abnormality occurs in segregation of chromosomes (or non disjunction of chromosome) that result in trisomy.

204. (c) Turner's syndrome is a chromosome disorder in which cells have only one copy of X chromosome.

205. (b) A girl is colour blind when she receives mutated allele of this trait on X-chromosome from both the parents. A colour blind father only can give mutated allele (X^c) to his daughter and a carrier mother (X^cX) or colour blind mother (X^cX^c) can pass X^c allele to her daughter.

206. (b) Down syndrome is an autosomal chromosomal aberration, i.e., trisomy of autosome 21. Hence, sex chromosome will be same as of a normal male child i.e. XY.

207. (d) Haemophilia (Royal disease): Sex linked recessive disease.

In this, a protein involved in the blood clotting is affected.

A simple cut results in non-stop bleeding.

The heterozygous female (carrier) for haemophilia may transmit the disease to sons.

The possibility of a female becoming a haemophilic is very rare because mother has to be at least carrier and father should be haemophilic (unviable in the later stage of life).

208. (d) Phenylketonuria is a genetic disorder, caused by mutations in both alleles of gene for phenylalanine hydroxylase found on chromosome 12. It is an autosomal recessive order, i.e., inherited from parents to offspring.

209. (a) In this case, father is normal & mother is carrier. Colour blindness is X - linked recessive disorder which is transferred to a daughter from a colour blind father only.

210. (c) Extrachromosomal inheritance takes through mother. Offspring inherits the cytoplasm & cytoplasmic DNA completely from the female parent & male contributes to only nuclear DNA.

CHAPTER 5

Molecular Basis of Inheritance

DNA

1. Given below are two statements: [MR*] *(2023)*

Statement I: In prokaryotes, the positively charged DNA is held with some negatively charged proteins in a region called nucleoid.

Statement II: In eukaryotes, the negatively charged DNA is wrapped around the positively charged histone octamer to form nucleosome.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is incorrect but Statement II is true.
b. Both Statement I and Statement II are true.
c. Both Statement I and Statement II are false.
d. Statement I is correct but Statement II is false.

2. Match List-I with List-II: [MR*] *(2022 Re)*

	List-I		List-II
(A)	Bacteriophage $\phi \times 174$	(I)	48502 base pairs
(B)	Bacteriophage Lambda	(II)	5386 nucleotides
(C)	*Escherichia coli*	(III)	3.3×10^9 Base pairs
(D)	Haploid content of human DNA	(IV)	4.6×10^6 base pairs

Choose the correct answer from the options given below:

a. A-I, B-II, C-IV, D-III b. A-I, B-II, C-III, D-IV
c. A-II, B-IV, C-I, D-III d. A-II, B-I, C-IV, D-III

3. If A and C make 30% and 20% of DNA, respectively, what will be the percentage composition of T and G? *(2022 Re)*

a. T : 20%, G : 20% b. T : 20%, G : 30%
c. T : 30%, G : 20% d. T : 30%, G : 30%

4. If the length of a DNA molecule is 1.1 metres, what will be the approximate number of base pairs? *(2022)*

a. 6.6×10^6 bp b. 3.3×10^9 bp
c. 6.6×10^9 bp d. 3.3×10^6 bp

5. Read the following statements and choose the set of correct statements [MR*] *(2022)*

A. Euchromatin is loosely packed chromatin
B. Heterochromatin is transcriptionally active
C. Histone octomer is wrapped by negatively charged DNA in nucleosome
D. Histones are rich in lysine and arginine
E. A typical nucleosome contains 400 bp of DNA helix

Choose the correct answer from the options given below.

a. A, C and E only b. B, D and E only
c. A, C and D only d. B and E only

6. Complete the flow chart on central dogma. [MR*] *(2021)*

(A) $\xrightarrow{\text{DNA}}$ $\xrightarrow{(B)}$ mRNA $\xrightarrow{(C)}$ (D)

a. (A)-Translation;(B)-Replication;
(C)-Transcription;(D)- Transduction
b. (A)-Replication;(B)-Transcription;
(C)-Translation; (D)-Protein
c. (A)-Transduction;(B)-Translation;
(C)-Replication; (D)-Protein
d. (A)-Replication;(B)-Transcription
(C)-Transduction;(D)-Protein

7. If Adenine makes 30% of the DNA molecule, what will be the percentage of Thymine, Guanine and Cytosine in it? [MR*] *(2021)*

a. T : 20; G : 20; C : 30 b. T : 30; G : 20; C : 20
c. T : 20; G : 25; C : 25 d. T : 20; G : 30; C : 20

8. Which one of the following statement about histones is wrong? *(2021)*

a. The pH of histones is slightly acidic.
b. Histones are rich in amino acids - Lysine and Arginine.
c. Histones carry positive charge in the side chain.
d. Histones are organized to form a unit of 8 molecules.

9. Which of the following statements is correct? *(2020)*

a. Adenine pairs with thymine through one H-bond
b. Adenine pairs with thymine through three H-bonds.
c. Adenine does not pair with thymine.
d. Adenine pairs with thymine through two H-bonds.

10. If the distance between two consecutive base pairs is 0.34 nm and the total number of base pairs of a DNA double helix in a typical mammalian cell is 6.6×10^9 bp, then the length of the DNA is approximately: *(2020)*

a. 2.5 meters b. 2.2 meters
c. 2.7 meters d. 2.0 meters

11. In the polynucleotide chain of DNA, a nitrogenous base is linked to the -OH of: *(2020-Covid)*

a. 3'C pentose sugar b. 5'C pentose sugar
c. 1'C pentose sugar d. 2'C pentose sugar

12. *E. Coli* has only 4.6×10^6 base pairs and completes the process of replication within 18 minutes, then the average rate of polymerisation is approximately- *(2020-Covid)*
a. 3000 base pairs/second b. 4000 base pairs/second
c. 1000 base pairs/second d. 2000 base pairs/second

13. Purines found both in DNA and RNA are *(2019)*
a. Adenine and thymine b. Adenine and guanine
c. Guanine and cytosine d. Cytosine and thymine

14. The association of histone H_1 with a nucleosome indicates: *(2017-Delhi)*
a. Transcription is occurring
b. DNA replication is occurring
c. The DNA is condensed into a chromatin fibre
d. The DNA double helix is exposed

15. DNA fragments are: *(2017-Delhi)*
a. Positively charged
b. Negatively charged
c. Neutral
d. Either positively or negatively charged depending on their size

16. Identify the correct order of organisation of genetic material from largest to smallest: *(2015 Re)*
a. Genome, chromosome, nucleotide, gene
b. Genome, chromosome, gene, nucleotide
c. Chromosome, genome, nucleotide, gene
d. Chromosome, gene, genome, nucleotide

17. The diagram shows an important concept in the genetic implication of DNA Fill in the blanks A to C: *(2013)*

DNA —A→ mRNA —B→ Protein —Proposed by C→

a. A-translation, B-extension, C-Rosalind Franklin
b. A-transcription, B-replication, C-James Watson
c. A-translation, B-transcription, C-Erwin Chargaff
d. A-transcription, B-translation, C-Francis Crick

. What are those structures that appear as 'beads-on-string' in the chromosomes when viewed under electron microscope? *(2011 Pre)*
a. Base pairs b. Genes
c. Nucleotides d. Nucleosomes

. Which does not follow central dogma of molecular biology? *(2010 Pre)*
a. Mucor b. *Chlamydomonas*
c. HIV d. Pea

20. 3' → 5' phosphodiester linkage occurs between: *(2010 Mains)*
a. One DNA and other DNA strands
b. One nucleoside with another nucleoside
c. One nucleotide with another nucleotide
d. One nitrogenous base with pentose

21. Segment of DNA which acts as an instrument for synthesis of protein is: *(200*
a. Nucleoside b. Ribose
c. Nucleotide d. Gene

22. In DNA molecule: [MR*] *(200*
a. Proportion of A to T varies with the organism
b. There are two antiparallel strands running in 5' → 3' and 3' → 5'
c. Amount of purine and pyrimidine nucleotides is not always equal
d. There are two parallel strands running in 5' → 3' direction

23. The two polynucleotide chains of DNA are: *(200*
a. Discontinuous b. Antiparallel
c. Parallel d. Semi-conservative

24. DNA is very long. It is accommodated in small sized nucleus by: *(200*
a. DNAase digestion
b. Super coiling
c. Elimination of repetitive DNA
d. Deletion of nonessential genes

25. Anti-parallel strands of DNA molecule means: *(200*
a. One strand turns clockwise
b. One strand turns anticlockwise
c. Phosphate group of the two strands share the same position at their ends
d. Phosphate group at the start of two DNA strands are at opposite positions

26. The following ratio is generally constant for a given species: [MR*] *(200*
a. T + C / G + A b. G + C / A + T
c. A + C / T + G d. A + G/ C + T

27. The telomeres of eukaryotic chromosomes consist of short sequences of: *(200*
a. Cytosine rich repeats b. Adenine rich repeats
c. Guanine rich repeats d. Thymine rich repeats

28. In a DNA percentage of thymine is 20% then what is the percentage of guanine? *(200*
a. 20% b. 40%
c. 30% d. 60%

29. Length of one loop of B- DNA: [MR*] *(200*
a. 3.4 nm b. 0.34 nm
c. 20 nm d. 10 nm

30. Number of base pairs in human chromosomes: *(199*
a. 3×10^9 b. 3×10^7
c. 6×10^9 d. 6×10^7

31. Gene composed of: *(199*
a. Amino acids b. Polynucleotide
c. Fatty acid d. Nitrogen bases

32. Molecular weight of DNA in yeast is: *(199*
a. 2.56×10^9 b. 0.5×10^6
c. 7×10^7 d. 6×10^9

33. Genetic material of prokaryotic cell: *(1999)*
a. Non-histonic double stranded DNA
b. Histonic double stranded DNA
c. Histone & DNA both are absent
d. Histone without DNA

34. Genes are packaged into a bacterial chromosome by: *(1997)*
a. Acidic protein b. Actin
c. Histones d. Basic protein

35. Centromere is a part of: *(1997)*
a. Chromosome b. Endoplasmic reticulum
c. Ribosomes d. Mitochondria

36. Nucleosome core is made of: *(1993)*
a. H_1, H_2A, H_2B and H_3 b. H_1, H_2A, H_2B and H_4
c. H_2, H_2A, H_2B, H_3 and H_4 d. H_2A, H_2B, H_3 and H_4

37. The transforming principle of *Pneumococcus* as found out by Avery, Macleod and McCarty was: *(1993)*
a. mRNA b. DNA
c. Protein d. Polysaccharide

38. A DNA with unequal nitrogen bases would most probably be: *(1993)*
a. Single stranded b. Double stranded
c. Triple stranded d. Four stranded

39. Nucleotide arrangement in DNA can be seen by: *(1993)*
a. X-ray crystallography b. Electron microscope
c. Ultracentrifuge d. Light microscope

40. A segment of DNA has 120 adenine and 120 cytosine bases. The total number of nucleotides present in the segment is: *(1991)*
a. 120 b. 240
c. 60 d. 480

41. An octamer of 4 histones complexed with DNA forms: *(1990)*
a. Endosome b. Nucleosome
c. Mesosome d. Centromere

42. Which is not consistent with double helical structure of DNA? *(1990)*
a. A = T, C = G
b. Density of DNA decreases on heating
c. A + T/C + G is not constant
d. Both (a) and (b)

43. Diploid chromosome number in human is: *(1989)*
a. 46 b. 44
c. 48 d. 42

44. In double helix of DNA, the two DNA strands are: *(1988)*
a. Coiled around a common axis
b. Coiled around each other
c. Coiled differently
d. Coiled over protein sheath

The Search For Genetic Material And RNA World

45. Unequivocal proof that DNA is the genetic material was first proposed by [MR*] *(2021)*
a. Wilkins and Franklin
b. Fedrick, Griffith
c. Alfred Hershey and Martha Chase
d. Avery, Macleod and McCarthy

46. Given below are two statements: [MR*] *(2021)*
Statement I: RNA mutates at a faster rate
Statement II: Viruses having RNA genome and shorter life span mutate and evolve faster
In the light of the above statements, choose the correct answer from the options given below
a. Statement I false but Statement II is true
b. Both Statement I and Statement II are true.
c. Both Statement I and Statement II are false.
d. Statement I is true but Statement II is false.

47. Which scientist conducted an experiment with ^{32}P and ^{35}S labelled phages for demonstrating that DNA is the genetic material? *(2021-Manipur)*
a. James D. Watson and F.H.C. Crick
b. A. D Hershey and M.J. Chase
c. F. Griffith
d. O.T. Avery, C.M. MacLeod and M. McCarty

48. Given below are two statements: *(2021-Manipur)*
Statement I: RNA being unstable, mutate at a faster rate.
Statement II: RNA can directly code for synthesis of proteins hence can easily express the characters.
In the light of the above statements, choose the correct answer from the options given below
a. **Statement I** is correct but **Statement II** is incorrect
b. **Statement I** is incorrect but **Statement II** is correct
c. Both **Statement I** and **Statement II** are correct
d. Both **Statement I** and **Statement II** are incorrect

49. With reference to Hershey and Chase experiments: [MR*] *(2021-Manipur)*
Select the **correct** statements
A. Viruses grown in the presence of radioactive phosphorus contained radioactive DNA
B. Viruses grown on radioactive sulphur contained radioactive proteins
C. Viruses grown on radioactive phosphorus contained radioactive protein
D. Viruses grown on radioactive sulphur contained radioactive DNA
E. Viruses grown on radioactive protein contained radioactive DNA
Choose the **most appropriate** answer from the options given below
a. (D) and (E) only b. (A) and (B) only
c. (A) and (C) only d. (B) and (D) only

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50. If DNA contained sulfur instead of phosphorus and proteins contained phosphorus instead of sulfur, what would have been the outcome of Hershey and Chase experiment? *(2022 Re)*

a. Radioactive phosphorus in bacterial cells
b. No radioactive sulfur in bacterial cells
c. Both radioactive sulfur and phosphorus in bacterial cells
d. Radioactive sulfur in bacterial cells

51. Ten *E.coli* with ^{15}N- dsDNA are incubated in medium containing ^{14}N nucleotide. After 60 minutes, how many *E coli* cells will have DNA totally free from ^{15}N? *(2022)*

a. 80 cells b. 20 cells
c. 40 cells d. 60 cells

52. The term 'Nuclein' for the genetic material was used by: *(2020-Covid)*

a. Miescher b. Chargaff
c. Mendel d. Franklin

53. The experimental proof for semiconservative replication of DNA was first shown in a: *(2018)*

a. Fungus b. Bacterium
c. Plant d. Virus

54. Select the correct match *(2018)*

a. Ribozyme — Nucleic acid
b. F_2 × Recessive parent — Dihybrid cross
c. T.H. Morgan — Transduction
d. G. Mendel — Transformation

55. The final proof for DNA as the genetic material came from the experiments of *(2017-Delhi)*

a. Griffith
b. Hershey and Chase
c. Avery, Mcleod and McCarty
d. Hargobind Khorana

56. A molecule that can act as a genetic material must fulfill the traits given below, except: *(2016 - II)*

a. It should be unstable structurally and chemically
b. It should provide the scope for slow changes that are required for evolution
c. It should be able to express itself in the form of 'Mendelian characters'
d. It should be able to generate its replica

57. Taylor conducted the experiment to prove semi- conservative mode of chromosome replication on: *(2016 - II)*

a. *Drosophila melanogaster* b. *E. coli*
c. *Vinca rosea* d. *Vicia faba*

58. Which of the following rRNA acts as structural RNA as well as ribozyme in bacteria? *(2016 - II)*

a. 23 S rRNA b. 5.8 S rRNA
c. 5 S rRNA d. 18 S rRNA

59. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are: *(2015)*

a. G = 17%, A = 33%, T = 33%
b. G = 8.5 %, A = 50 %, T = 24.5 %
c. G = 34%, A = 24.5%, T = 24.5%
d. G = 17%, A = 16.5%, T = 32.5%

60. Which one of the following is not applicable to RNA? *(2015 Re)*

a. 5' phosphoryl and 3' hydroxyl ends
b. Heterocyclic nitrogenous bases
c. Chargaff's rule
d. Complementary base pairing

61. Transformation was discovered by: *(2014)*

a. Watson and Crick b. Messelson and Stahl
c. Hershey and Chase d. Griffith

62. The unequivocal proof of DNA as the genetic material came from the studies on a: *(2011 Mains)*

a. Viroid b. Bacterial virus
c. Bacterium d. Fungus

63. Whose experiments cracked DNA and discovered triplet nature of genetic code? *(2007)*

a. Beadle and Tatum b. Hershey and Chase
c. Morgan and Sturtevant d. Nirenberg and Matthaei

64. Transformation experiment was first performed on which bacteria? *(2005)*

a. *E. coli* b. *Diplococcus pneumoniae*
c. *Salmonella* d. *Pasteurella pestis*

65. Similarity in DNA and RNA: *(2004)*

a. Both are polymer of nucleotides
b. Both have similar pyrimidine
c. Both have similar sugar
d. Both are genetic material

66. DNA synthesis can be specifically measured by estimating the incorporation of radio-labelled: *(1997)*

a. Thymidine b. Deoxyribose sugar
c. Uracil d. Adenine

67. Radiotracer technique shows that DNA is in: *(1996)*

a. Multi-helix stage b. Single-helix stage
c. Double-helix stage d. None of these

68. Who proved that DNA is basic genetic material? *(1993)*

a. Griffith b. Watson
c. Boveri and Sutton d. Hershey and Chase

69. Experimental material in the study of DNA replication has been: *(1992)*

a. *Escherichia coli*
b. *Neurospora crassa*
c. *Pneumococcus*
d. *Drosophila melanogaster*

70. *Escherichia coli* fully labelled with ^{15}N is allowed to grow in ^{14}N medium. The two strands of DNA molecule of the first generation bacteria have: [MR*] *(1992)*

a. Different density and do not resemble parent DNA
b. Different density but resemble parent DNA
c. Same density and resemble parent DNA
d. Same density but do not resemble parent DNA

Replication

71. Given below are two statements: [MR*] *(2022 Re)*

Statement I: DNA polymerases catalyses polymerisation only in one direction, that is 5' → 3'

Statement II: During replication of DNA, on one strand the replication is continuous while on the other strand it is discontinuous.

In the light of the above statements, choose the correct answer from the options given below

a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both Statement I and Statement II are incorrect
d. Statement I is correct but Statement II is incorrect

72. During DNA replication, Okazaki fragments are used to elongate *(2017-Delhi)*

a. The leading strand towards replication fork
b. The lagging strand towards replication fork
c. The leading strand away from replication fork
d. The lagging strand away from the replication fork

73. Select the correct option: *(2014)*

	Direction of RNA synthesis	Direction of reading of the template DNA strand
a.	3' → 5'	3' → 5'
b.	5' → 3'	3' → 5'
c.	3' → 5'	5' → 3'
d.	5' → 3'	5' → 3'

74. Okazaki fragments during DNA replication: *(2007)*

a. Polymerise in 3' → 5' direction and form replication fork
b. Prove semi conservative nature of DNA replication
c. Polymerise in 5' → 3' direction and explain 3' → 5' DNA replication
d. Cause transcription

75. During replication of a bacterial chromosome, DNA synthesis starts from a replication origin site and: *(2004)*

a. Is facilitated by telomerase
b. Moves in one direction of the site
c. Moves in bi-directional way
d. RNA primers are involved

76. *E.Coli* about to replicate was placed in a medium containing radioactive thymidine for five minutes. Then it was made to replicate in a normal medium. Which of the following observation shall be correct? *(2001)*

a. Both the strands of DNA will be radioactive
b. One strand radioactive
c. Each strand half radioactive
d. None is radioactive

77. Method of DNA replication in which two strands of DNA separates and synthesise new strands: *(2000)*

a. Dispersive b. Conservative
c. Semiconservative d. Non-conservative

78. A cup have 10^5 bacterial cells. Each bacterial cell divides in 35 minutes. What shall be the number of bacteria after 175 min? *(1999)*

a. 2×10^5 b. 5×10^5
c. 32×10^5 d. 16×10^5

79. There are special proteins that help to open up DNA double helix in front of the replication fork. These proteins are: *(1994)*

a. DNA ligase b. DNA topoisomerase I
c. DNA gyrase d. DNA polymerase I

80. During DNA replication, the strands separate by: *(1993)*

a. DNA polymerase b. Topoisomerase
c. Unwindase/helicase d. Gyrase

81. DNA replication is: *(1989)*

a. Conservative and discontinuous
b. Semiconservative and semidiscontinuous
c. Semiconservative and discontinuous
d. Conservative

Transcription

82. What is the role of RNA polymerase III in the process of transcription in Eukaryotes? *(2023)*

a. Transcription of only snRNAS
b. Transcription of rRNAs (28S, 18S and 5.8S)
c. Transcription of tRNA, 5 srRNA and snRNA
d. Transcription of precursor of mRNA

83. Which one of the following is the sequence on corresponding coding strand, if the sequence on mRNA formed is as follow *(2023)*

5'AUCGAUCGAUCGAUCGAUCGAUCG AUCG 3'?

a. 3' ATCGATCGATCGTCGATCG ATCGATCG 5'
b. 5' UAGCUAGCUAGCUAGCUA GCUAGC UAGC 3'
c. 3' UAGCUAGCUAGCUAGCUA GCUAGCUAGC 5'
d. 5' ATCGATCGATCGATCGATCG ATCGATCG 3'

84. Given below are two statements. *(2023-Manipur)*

Statement I: The process of copying genetic information from one strand of the DNA into RNA is termed as transcription.

Statement II: A transcription unit in DNA is defined primarily by the three regions in the DNA i.e., a promoter, the structural gene and a terminator.

In the light of the above statements, choose the correct answer from the options given below:

a. **Statement I** is true but **Statement II** is false
b. **Statement I** is false but **Statement II** is true
c. Both **Statement I** and **Statement II** are true
d. Both **Statement I** and **Statement II** are false

85. What is the role of RNA polymerase III in the process of transcription in eukaryotes? *(2021)*

a. Transcribes tRNA, 5s rRNA and sn RNA
b. Transcribes precursor of mRNA
c. Transcribes only snRNAs
d. Transcribes rRNAs (28S, 18S and 5.8S)

86. Identify the correct statement. [MR*] *(2021)*

a. RNA polymerase binds with Rho factor to terminate the process of transcription in bacteria.
b. The coding strand in transcription unit is copied to an mRNA.
c. Split gene arrangement is characteristic of prokaryotes.
d. In capping, methyl guanosine triphosphate is added to the 3' end of hnRNA.

87. Which is the "Only enzyme" that has "Capability" to catalyse Initiation, Elongation and Termination in the process of transcription in prokaryotes? *(2021)*

a. DNA dependent RNA polymerase
b. DNA Ligase
c. DNase
d. DNA dependent DNA polymerase

. Name the enzyme that facilitates opening of DNA helix during transcription. *(2020)*

a. DNA helicase b. DNA polymerase
c. RNA polymerase d. DNA ligase

9. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA? *(2018)*

a. AGGUAUCGCAU b. UGGTUTCGCAT
c. ACCUAUGCGAU d. UCCAUAGCGUA

90. Spliceosomes are not found in cells of *(2017-Delhi)*

a. Plants b. Fungi
c. Animals d. Bacteria

91. Which of the following RNAs should be most abundant in animal cell? *(2017-Delhi)*

a. r-RNA b. t-RNA
c. m-RNA d. sn-RNA

92. DNA-dependent RNA polymerase catalyses transcription of one strand of the DNA which is called the: *(2016, I)*

a. Alpha strand b. Antistrand
c. Template strand d. Coding strand

93. Which one of the following is not a part of a transcription unit in DNA? *(2012 Pre)*

a. The structural gene b. The inducer
c. A terminator d. A promoter

94. Removal of introns and joining of exons in a defined mRNA during transcription in called: *(2012 Pre)*

a. Splicing b. Looping
c. Inducing d. Slicing

95. Which one of the following also acts as a catalyst in a bacterial cell? *(2011 Pre)*

a. 23S rRNA b. 5S rRNA
c. sn RNA d. hn RNA

96. In eukaryotic cell transcription, RNA splicing and RNA capping take place inside: *(2010 Mains)*

a. Nucleus b. Ribosomes
c. E.R d. Dictyosomes

97. Removal of introns and joining the exons in a defined order in a transcription unit is: *(2009)*

a. Splicing b. Capping
c. Tailing d. Transformation

98. Molecular basis of tissue/organ differentiation depends upon modulation of transcription by: *(2007)*

a. RNA polymerase b. Transcription factor
c. Ribosome d. Anticodon

99. During transcription, holoenzyme RNA polymerase binds to DNA sequence and DNA assumes a saddle like structure at that point. The sequence is called: *(2007, 2005)*

a. AAAT box b. TATA box
c. GGTT box d. CAAT box

100. During transcription, if the nucleotide sequence of the DNA strand that is being coded is ATACG, then the nucleotide sequence in the mRNA would be: *(2004)*

a. TCTGG b. UAUGC
c. UATGC d. TATGC

101. After a mutation at a genetic locus the character of an organism changes due to the change in: *(2004)*

a. DNA replication
b. Protein synthesis pattern
c. RNA transcription pattern
d. Protein structure

102. During transcription, the DNA site at which RNA polymerase binds is called *(2003)*

a. Promoter b. Regulator
c. Receptor d. Enhancer

103. What would happen if in a gene encoding a polypeptide of 50 amino acids, 25th codon (UAU) is mutated to UAA? *(2003)*

a. A polypeptide of 24 amino acids will be formed
b. Two polypeptides of 24 and 25 amino acids will be formed
c. A polypeptide of 49 amino acids will be formed
d. A polypeptide of 25 amino acids will be formed

104. Exon part of mRNAs have code for: *(2002)*

a. Protein b. Lipid
c. Carbohydrate d. Phospholipid

105. Which of the following reunites the exon segments after RNA splicing? *(2002)*

a. RNA polymerase b. RNA primase
c. RNA ligase d. RNA proteases

106. Types of RNA polymerase required in nucleus for RNA synthesis: *(2001)*

a. 1 b. 2
c. 3 d. 4

107. mRNA is synthesised on DNA template in which direction? *(2001)*

a. 5'→ 3' b. 3' → 5'
c. Both d. Any

108. At the time of organogenesis genes regulate the process at different levels and at different time due to *(2001)*

a. Promoter b. Regulator
c. Intron d. Exon

109. Initiation codon in eukaryotes: *(1999)*

a. UGA b. CCA
c. AGA d. AUG

110. Minor change in gene's structure is called. *(1999)*

a. Reversible mutation b. Point mutation
c. Forward mutation d. Backward mutation

111. Which of the following excercise a control over transcription? *(1998)*

a. Operator b. Regulator
c. Promotor d. Recon

112. Segments of DNA which can move in genome? *(1998)*

a. Transposons b. Introns
c. Exons d. Cistrons

113. The maximum formation of m-RNA occurs in. *(1996)*

a. Ribosome b. Nucleoplasm
c. Cytoplasm d. Nucleolus

114. If the sequence of bases in DNA is ATTCGATG, then the sequence of bases in its transcript will be *(1995)*

a. GUAGCUUA b. AUUCGAUG
c. CAUCGAAU d. UAAGCUAC

115. If the DNA codons are ATG ATG ATG and a cytosine base is inserted at the beginning, then which of the following will result? *(1995)*

a. CAT GAT GATG b. A non-sense mutation
c. CATG ATG ATG d. CA TGA TGA TG

116. In split genes, the coding sequences are called: *(1995)*

a. Exons b. Cistrons
c. Introns d. Operons

117. Anticodon is an unpaired triplet of bases in an exposed position of: *(1995)*

a. tRNA b. mRNA
c. rRNA d. Both (b) and (c)

118. The process of transfer of genetic information from DNA to RNA or the formation of RNA from DNA *(1995)*

a. Transversion b. Transcription
c. Translation d. Translocation

Genetic Code

119. In which disorder change of single base pair in the gene for beta globin chain results in change of glutamic acid to valine? *(2023-Manipur)*

a. Thalassemia b. Sickle cell anemia
c. Haemophilia d. Phenylketonuria

120. Select the correct statements about sickle cell anaemia. [MR*] *(2023-Manipur)*

A. There is a change in gene for beta globin.
B. In the beta globin, there is valine in the place of Lysine.
C. It is an example of point mutation.
D. In the normal gene U is replaced by A.

Choose the correct answer from the options given below:

a. (B), (C) and (D) only b. (B) and (D) only
c. (A), (B) and (D) only d. (A) and (C) only

121. The salient features of genetic code are: [MR*] *(2023-Manipur)*

A. The code is pentadinomic.
B. UGA act as initiator codon.
C. The code is unambiguous and specific.
D. The code is nearly universal.

Choose the most appropriate answer from the options given below:

a. (A) and (D) only b. (B) and (C) only
c. (A) and (B) only d. (C) and (D) only

122. Against the codon 5' UAC 3', what would be the sequence of anticodon on tRNA? *(2022 Re)*

a. 5' GUA 3' b. 5' AUG 3'
c. 5' ATG 5' d. 5' GUA 3'

123. Statement I: The codon 'AUG' codes for methionine and also initiates.

Statement II: 'AAA' and 'AAG' both codons code for the amino acid lysine.

In the light of the above statements, choose the correct answer from the options given below. *(2021)*

a. Both statement I and statement II are false
b. Statement I is correct but statement II is false
c. Statement I is incorrect but statement II is true
d. Both statement I and statement II are true

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124. Under which of the following conditions will there be no change in the reading frame of following mRNA? *(2019)*
5'AACAGCGGUGCUAUU3'
a. Insertion of G at 5th position
b. Deletion of G from 5th position
c. Insertion of A and G at 4th and 5th positions respectively
d. Deletion of GGU from 7th, 8th and 9th positions

125. Which of the following features of genetic code does allow bacteria to produce human insulin by recombinant DNA technology? *(2019)*
a. Genetic code is not ambiguous
b. Genetic code is redundant
c. Genetic code is nearly universal
d. Genetic code is specific

126. If there are 999 bases in an RNA that codes for a protein with 333 amino acids, and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered? *(2017-Delhi)*
a. 1 b. 11
c. 33 d. 333

127. Which one of the following is the starter codon? [MR*] *(2016 - I)*
a. AUG b. UGA
c. UAA d. UAG

128. Which is not a salient feature of genetic code? *(2010 Pre)*
a. Ambiguous b. Universal
c. Specific d. Degenerate

129. Which one of the following is a wrong statement regarding mutations? *(2012 Mains)*
a. Deletion and insertion of base pairs cause frame-shift mutations
b. Cancer cells commonly show chromosomal aberrations
c. UV and Gamma rays are mutagens
d. Change in a single base pair of DNA does not cause mutation

130. What is not true for genetic code? *(2009)*
a. It is degenerative
b. It is nearly universal
c. A code in mRNA is read in a noncontiguous fashion
d. It is unambiguous

131. Antisense technology is: *(2008)*
a. Use of complementary RNA to stop expression of specific gene
b. RNA polymerase producing DNA
c. A cell with foreign antigen used for synthesis of antigens
d. Production of Somaclonal variants in tissue culture

132. Which one is correctly matched? *(2008)*
a. AUG, ACG - Start codon or methionine
b. UUA, UCA - Leucine
c. GUU - Alanine
d. UAG, UGA - Stop codon

133. In a mutational event, when adenine is replaced by guanine, it is a case of: *(2004)*
a. Transcription b. Transition
c. Transversion d. Frame shift mutation

134. In the genetic code dictionary, how many codons are used to code for all the 20 essential amino acids? *(2003)*
a. 20 b. 64
c. 61 d. 60

135. Degeneration of a genetic code is attributed to the: *(2003)*
a. First member of a codon
b. Second member of a codon
c. Entire codon
d. Third member of a codon

136. Which one of the following triplet codes, is correctly matched with its specificity for an amino acid in protein synthesis or as 'start' or 'stop' codon? *(2003)*
a. UCG – Start b. UUU – Stop
c. UGU – Leucine d. UAC – Tyrosine

137. Which of the following discoveries resulted in a Nobel Prize? *(2003)*
a. X-rays induce sex-linked recessive lethal mutations
b. Cytoplasmic inheritance
c. Recombination of linked genes
d. Genetic engineering

138. Out of 64 codons, 61 codons code for 20 types of amino acid. It is called: *(2002)*
a. Degeneracy of genetic code
b. Overlapping of gene
c. Wobbling of codon
d. University of codons

139. Change in sequence of nucleotide in DNA is called as: *(2002)*
a. Mutagen b. Mutation
c. Recombination d. Translation

140. Most of the mutations are: *(2000)*
a. Harmful b. Harmful and recessive
c. Beneficial d. Dominant

141. Which of the following is initiation codon? *(2000)*
a. UAG b. AUC
c. AUG d. CCU

142. What change occurs by changing one base in DNA? *(1999)*
a. Always a change of one amino acid in protein.
b. Change in complex sequences of amino acid.
c. Always a change in property of protein
d. Does not necessarily change the phenotype.

143. Point mutation induced by: *(1998)*
a. Adenine b. Guanine
c. 3-cytosine d. Bromouracil

144. Multivalent chromosome form by: *(1998)*
a. Inversion b. Deletion
c. Reciprocal translocation d. Point mutation

145. The mutations are mainly responsible for: *(1997)*
a. Increasing the population rate
b. Maintaining genetic continuity
c. Constancy in organisms
d. Variation in organisms

146. The codons causing chain termination are: *(1997)*
a. AGT, TAG, UGA b. UAG, UGA, UAA
c. TAG, TAA, TGA d. GAT, AAT, AGT

147. Which of the following serves as a termination codon? *(1996)*
a. UAG b. AGA
c. AUG d. GCG

148. Identify the one which causes mutation? *(1996)*
a. Cosmic rays b. Colchicine
c. Crossing over d. X-rays

149. Initiation codon in eukaryotes is: *(1994)*
a. GAU b. AGU
c. AUG d. UAG

150. Initiation codon of protein synthesis (in eukaryotes) *(1993)*
a. GUA b. GCA
c. CCA d. AUG

151. Because most of the amino acids are represented by more than one codon, the genetic code is: *(1993)*
a. Overlapping b. Wobbling
c. Degenerate d. Generate

152. Khorana first deciphered the triplet codons of: *(1992)*
a. Serine and isoleucine
b. Cysteine and valine
c. Tyrosine and tryptophan
d. Phenylalanine and methionine

153. In the genetic dictionary, there are 64 codons as: *(1990)*
a. 64 amino acids are to be coded
b. 64 types of tRNAs are present
c. There are 44 nonsense codons and 20 sense codons
d. Genetic code is triplet

154. Genetic code consists of: *(1988)*
a. Adenine and Guanine b. Cytosine and Uracil
c. Cytosine and Guanine d. All the above

Translation

155. How many different proteins does the ribosome consist of? *(2023)*
a. 20 b. 80
c. 60 d. 40

156. The process of translation of mRNA to proteins begins as soon as: *(2022)*
a. The tRNA is activated and the larger subunit of ribosome encounters mRNA
b. The small subunit of ribosome encounters mRNA
c. The larger subunit of ribosome encounters mRNA
d. Both the subunits join together to bind with mRNA

157. Which of the following RNAs is not required for the synthesis of protein? *(2021)*
a. tRNA b. rRNA
c. siRNA d. mRNA

158. The first phase of translation is: *(2020)*
a. Recognition of DNA molecule
b. Aminoacylation of tRNA
c. Recognition of an anti-codon
d. Binding of mRNA to ribosome

159. Which one of the following is wrongly matched? [MR*] *(2014)*
a. Operon-Structural genes, operator and promoter
b. Transcription-Writing information from DNA to tRNA
c. Translation-Using information in mRNA to make protein
d. Repressor protein-Binds to operator to stop enzyme synthesis

160. Removal of RNA polymerase III from nucleoplasm will affect the synthesis of: *(2012 Pre)*
a. rRNA b. tRNA
c. hnRNA d. mRNA

161. If one strand of DNA has the nitrogenous base sequence as ATCTC, what would be the complementary RNA strand sequence? *(2012 Pre)*
a. ATCGU b. TTAGU
c. UAGAG d. AACTG

162. Antibiotic inhibiting interaction between tRNA and mRNA using protein synthesis in bacteria is: *(2006)*
a. Tetracycline b. Neomycin
c. Erythromycin d. Streptomycin

163. Amino acid sequence in protein synthesis is determined by sequence of: *(2006)*
a. rRNA b. rRNA
c. mRNA d. cDNA

164. Which form of RNA has a structure resembling clover leaf? *(2004)*
a. hnRNA b. mRNA
c. tRNA d. rRNA

165. During translation initiation in prokaryotes, a GTP molecule is needed in: *(2003)*
a. Formation of formyl-met-tRNA
b. Binding of 30S subunit of ribosome with mRNA
c. Association of 30S-mRNA with formyl-met-tRNA
d. Association of 50S subunit of ribsome with initiation complex

166. Anticodon occurs in: *(2000)*
a. tRNA b. mRNA
c. rRNA d. DNA

167. In three dimensional view, the molecule of tRNA is: *(2000)*
a. L-shaped b. S-shaped
c. Y- shaped d. E-shaped

168. The RNA that pick up specific amino acid from amino acid pool in the cytoplasm to ribosome during protein synthesis is called: *(1997)*
a. rRNA b. RNA
c. mRNA d. tRNA

169. Which of the following step of translation does not consume a high energy phosphate bond? *(1997)*
a. Peptidyl transferase reaction
b. Aminoacyl *t*-RNA binding to *A*-site
c. Translocation
d. Amino acid activation

170. In protein synthesis, the polymerisation of amino acids involves three steps. Which one of the following is not involved in the polymerisation of protein? *(1994)*
a. Termination b. Initiation
c. Elongation d. Transcription

171. The process of translation is: *(1993)*
a. Ribosome synthesis b. Protein synthesis
c. DNA synthesis d. RNA synthesis

Regulation of Gene Expression

172. Match List-I with List-II. [MR*] *(2023)*

List-I		List-II	
(A)	Gene '*a*'	(I)	β-galactosidase
(B)	Gene '*y*'	(II)	Transacetylase
(C)	Gene '*i*'	(III)	Permease
(D)	Gene '*z*'	(IV)	Repressor protein

Choose the correct answer from the option given below:
a. A-III, B-I, C-IV, D-II b. A-III, B-I, C-IV, D-III
c. A-II, B-III, C-IV, D-I d. A-III, B-IV, C-I, D-II

173. Name the component that binds to the operator region of an operon and prevents RNA polymerase from transcribing the operon. *(2023-Manipur)*
a. Promotor b. Regulator protein
c. Repressor protein d. Inducer

174. Which one of the following acts as an inducer for *lac* operon? *(2023-Manipur)*
a. Sucrose b. Lactose
c. Glucose d. Galactose

175. In *lac* operon, *z* gene codes for: *(2022 Re)*
a. Transacetylase b. β-galactosidase
c. Permease d. Repressor

176. Match List-I with List-II: *(2022 Re)*

List-I		List-II	
(A)	In *lac* operon *i* gene codes for	(I)	transacetylase
(B)	In *lac* operon *z* gene codes for	(II)	permease
(C)	In *lac* operon *y* gene codes for	(III)	β-galactosidase
(D)	In *lac* operon *a* gene codes for	(IV)	Repressor

Choose the correct answer from the options given below.
a. A-III, B-I, C-IV, D-II b. A-III, B-II, C-I, D-IV
c. A-IV, B-III, C-II, D-I d. A-I, B-I, C-III, D-II

177. In an *E. coli* strain *i* gene gets mutated and its product can not bind the inducer molecule. If growth medium is provided with lactose, what will be the outcome? *(2022)*
a. RNA polymerase will bind the promoter region
b. Only *z* gene will get transcribed
c. *z*, *y*, a genes will be transcribed
d. *z*, *y*, a genes will not be translated

178. Match the following genes of the Lac operon with their respective products : *(2019)*

A. *i* gene	i. β-galactosidase
B. *z* gene	ii. Permease
C. *a* gene	iii. Repressor
D. *y* gene	iv. Transacetylase

Select the correct option.

	(A)	(B)	(C)	(D)
a.	(i)	(iii)	(ii)	(iv)
b.	(iii)	(i)	(ii)	(iv)
c.	(iii)	(i)	(iv)	(ii)
d.	(iii)	(iv)	(i)	(ii)

179. Select the correct match: *(2018)*
a. Alec Jeffreys – *Streptococcus pneumoniae*
b. Alfred Hershey and Martha Chase – TMV
c. Matthew Meselson and F. Stahl – *Pisum sativum*
d. Francois Jacob and Jacques Monod – Lac operon

180. All of the following are part of an operon except: *(2018)*
a. An operator b. Structural genes
c. An enhancer d. A promoter

181. The equivalent of a structural gene is: *(2016 - II)*
a. Operon b. Recon
c. Muton d. Cistron

182. Gene regulation governing lactose operon of *E. coli* that involves the *lac I* gene product is: [MR*] *(2015)*
a. Negative and repressible because repressor protein prevents transcription
b. Feedback inhibition because excess of β-galactosidase can switch off transcription
c. Positive and inducible because it can be induced lactose
d. Negative and inducible because repressor protein prevents transcription

183. Which enzyme/s will be produced in a cell in which there is a nonsense mutation in the *lac Y* gene? *(2013)*
a. Lactose permease and transacetylase
b. β-galactosidase
c. Lactose permease
d. Transacetylase

184. Read the following four statements (A - D)
A. In transcription, adenosine pairs with uracil.
B. Regulation of lac operon by repressor is referred to as positive regulation.
C. The human genome has approximately 50,000 genes.
D. Haemophilia is a sex-linked recessive disease.
How many of the above statements are right? [MR*] *(2012 Mains)*
a. Two b. Three
c. Four d. One

185. Select the correct statement from A - D about lac operon: *(2010 Pre)*
A. Glucose or galactose may bind with repressor and inactivate it.
B. In the absence of lactose , the repressor binds with operator region.
C. Z-gene codes for permease.
D. This was elucidated by Jacob and Monod.
a. A and C b. B and D
c. A and B d. B and C

186. Lac operon consists of: *(2010 Mains)*
a. Four regulatory genes only
b. Two regulatory genes and two structural genes
c. Three regulatory genes and three structural genes
d. One regulatory gene and three structural genes

187. Differentiation of tissues and organs is connected with: *(2007)*
a. Differential expression of genes
b. Deletion of genes
c. Lethal mutations
d. Developmental mutations

188. A sequential expression of a set of human genes occurs when a steroid molecule binds to: *(2007)*
a. mRNA b. DNA sequence
c. tRNA d. Ribosome

189. *Escherichia coli* with mutated Z gene of lac operon cannot grow in medium containing only lactose as the source of energy because: [MR*] *(2005)*
a. Lac operon is constitutively active in these cells
b. They cannot synthesise functional β-galactosidase
c. In the presence of glucose, *Escherichia coli* cannot utilise lactose
d. The bacterium cannot transport lactose from the medium into the cell

190. What does "lac" refer to in what we call the lac operon? *(2003)*
a. Lactose b. Lactase
c. Lac insect d. The number 1,00,000

191. Jacob and Monod studied lactose metabolism in *E. Coli* and proposed operon concept. Operon concept applicable for: *(2002)*
a. All prokaryotes
b. All prokaryotes and some eukaryotes
c. All prokaryotes and all eukaryotes
d. All prokaryotes and some protozoans

192. In *E. Coli*, during lactose metabolism repressor binds to: *(2002)*
a. Regulator gene b. Operator gene
c. Structural gene d. Promoter gene

193. In negative operon: *(2001)*
a. Inducer binds with repressor
b. Co-repressor does not binds with repressor
c. Corepressor binds with inducer
d. cAMP have negative effect on be operon

194. Gene and cistron words are sometimes used synonymously because: *(2001)*
a. One cistron contains many genes
b. One gene contains many cistrons
c. One gene contains one cistron
d. One gene contains no dstron

195. In inducible operon, regulatory gene synthesise: *(1999)*
a. Promoter b. Operator
c. Repressor d. Aporepressor

196. After crossing two plants, the progenies are found to be male sterile. This phenomenon is found to be maternally inherited and is due to some genes which reside in: *(1997)*
a. Mitochondria b. Cytoplasm
c. Nucleus d. Chloroplast

197. The wild type *E.coli* cells are growing in normal medium with glucose. They are transferred to a medium containing only lactose as sugar. Which of the following changes take place? *(1995)*
a. The lac operon is induced
b. *E.coli* cells stop dividing
c. The lac operon is repressed
d. All operons are induced

198. The lac operon is an example of: *(1995)*
a. Repressible operon b. Overlapping genes
c. Arabinose operon d. Inducible operon

199. An environmental agent, which triggers transcription from an operon, is a: *(1995)*
a. Repressor b. Controlling element
c. Regulator d. Inducer

200. 'Lac operon' in *E.coli*, is induced by: *(1994)*
a. 'I' gene b. Promoter gene
c. β-galactosidase d. Lactose

Human Genome Project And DNA Fingerprinting

201. Expressed Sequence Tags (ESTs) refers to [MR*] *(2023)*
a. Certain important expressed genes.
b. All genes that are expressed as RNA.
c. All genes that are expressed as proteins.
d. All genes whether expressed or unexpressed.

202. The last chromosome sequenced in Human Genome Project was: *(2023-Manipur)*
a. Chromosome 6 b. Chromosome 1
c. Chromosome 22 d. Chromosome 14

203. DNA polymorphism forms the basis of: *(2022)*
a. Translation
b. Genetic mapping
c. DNA finger printing
d. Both genetic mapping and DNA finger printing

204. If a geneticist uses the blind approach for sequencing the whole genome of an organism, followed by assignment of function to different segments, the methodology adopted by him is called as: *(2022)*
a. Bioinformatics b. Sequence annotation
c. Gene mapping d. Expressed sequence tags

205. DNA fingerprinting involves identifying differences in some specific regions in DNA sequence, called as: *(2021)*
a. Repetitive DNA b. Single nucleotides
c. Polymorphic DNA d. Satellite DNA

206. Which is the basis of genetic mapping of human genome as well as DNA finger printing? *(2020-Covid)*
a. Single nucleotide polymorphism
b. Polymorphism in hnRNA sequence
c. Polymorphism in RNA sequence
d. Polymorphism in DNA sequence

207. Expressed Sequence Tags (ESTs) refers to : *(2019)*
a. Genes expressed as RNA b. Polypeptide expression
c. DNA polymorphism d. Novel DNA sequences

208. Which of the following is not required for any of the techniques of DNA fingerprinting available at present? *(2016 - I)*
a. Polymerase chain reaction
b. Zinc finger analysis
c. Restriction enzymes
d. DNA-DNA hybridisation

209. Which of the following is required as inducer(s) for the expression of Lac operon? *(2016 - I)*
a. Glucose b. Galactose
c. Lactose d. Lactose and Galactose

210. Satellite DNA is important because it: *(2015 Re)*
a. Shows high degree of polymorphism in population and also the same degree of polymorphism in an individual, which are heritable form parents to children.
b. Does not code for proteins and is same in all members of the population
c. Codes for enzymes needed for DNA replication
d. Codes for proteins needed in cell cycle.

211. Commonly used vectors for human genome sequencing are: *(2014)*
a. T/A Cloning Vectors b. T-DNA
c. BAC and YAC d. Expression Vectors

212. An analysis of chromosomal DNA using the southern hybridisation technique does not use: *(2014)*
a. PCR b. Electrophoresis
c. Blotting d. Autoradiography

213. What is it that forms the basis of DNA fingerprinting? *(2012 Mains)*
a. The relative proportions of purines and pyrimidines in DNA
b. The relative difference in the DNA occurrence in blood, skin and saliva
c. The relative amount of DNA in the ridges and grooves of the fingerprints
d. Satellite DNA occurring as highly repeated short DNA segments

214. PCR and Restriction Fragment Length Polymorphism are the methods for: *(2012 Pre)*
a. Genetic Fingerprinting b. Study of enzymes
c. Genetic transformation d. DNA sequencing

215. In history of biology, human genome project led to the development of *(2011 Mains)*
a. Bioinformatics b. Biosystematics
c. Biotechnology d. Biomonitoring

216. DNA fingerprinting refers to: *(2004)*
a. Analysis of DNA samples using imprinting devices
b. Techniques used for molecular analysis of different specimens of DNA
c. Techniques used for identification of fingerprints of individuals
d. Molecular analysis of profiles of DNA samples

217. In recent years, DNA sequences (nucleotide sequence) of mt-DNA and Y chromosomes were considered for the study of human evolution, because: *(2003)*
a. They are small, and therefore, easy to study
b. They are uniparental in origin and do not take part in recombination
c. Their structure is known in greater detail
d. They can be studied from the samples of fossil remains

Answer Key

1. (a)	2. (d)	3. (c)	4. (b)	5. (c)	6. (b)	7. (b)	8. (a)	9. (d)	10. (b)
11. (c)	12. (d)	13. (b)	14. (c)	15. (b)	16. (b)	17. (d)	18. (d)	19. (c)	20. (c)
21. (d)	22. (b)	23. (b)	24. (b)	25. (d)	26. (b)	27. (c)	28. (c)	29. (a)	30. (a)
31. (b)	32. (a)	33. (a)	34. (d)	35. (a)	36. (d)	37. (b)	38. (a)	39. (a)	40. (d)
41. (b)	42. (c)	43. (a)	44. (d)	45. (c)	46. (b)	47. (b)	48. (c)	49. (b)	50. (d)
51. (d)	52. (a)	53. (b)	54. (a)	55. (b)	56. (a)	57. (d)	58. (a)	59. (a)	60. (c)
61. (d)	62. (b)	63. (d)	64. (b)	65. (a)	66. (a)	67. (c)	68. (d)	69. (a)	70. (a)
71. (b)	72. (d)	73. (b)	74. (c)	75. (c)	76. (b)	77. (c)	78. (c)	79. (b)	80. (c)
81. (b)	82. (c)	83. (d)	84. (c)	85. (a)	86. (a)	87. (a)	88. (c)	89. (a)	90. (d)
91. (a)	92. (c)	93. (b)	94. (a)	95. (a)	96. (a)	97. (a)	98. (b)	99. (b)	100. (b)
101. (d)	102. (a)	103. (a)	104. (a)	105. (c)	106. (c)	107. (a)	108. (d)	109. (d)	110. (b)
111. (b)	112. (a)	113. (d)	114. (d)	115. (a)	116. (a)	117. (a)	118. (b)	119. (b)	120. (d)
121. (d)	122. (a)	123. (c)	124. (d)	125. (c)	126. (c)	127. (a)	128. (a)	129. (d)	130. (c)
131. (a)	132. (d)	133. (b)	134. (c)	135. (d)	136. (d)	137. (a)	138. (a)	139. (b)	140. (b)
141. (c)	142. (d)	143. (d)	144. (c)	145. (d)	146. (b)	147. (a)	148. (d)	149. (c)	150. (d)
151. (c)	152. (b)	153. (d)	154. (d)	155. (b)	156. (b)	157. (c)	158. (b)	159. (b)	160. (b)
161. (c)	162. (b)	163. (c)	164. (c)	165. (c)	166. (a)	167. (a)	168. (d)	169. (a)	170. (d)
171. (b)	172. (c)	173. (c)	174. (b)	175. (b)	176. (c)	177. (d)	178. (c)	179. (d)	180. (c)
181. (d)	182. (d)	183. (b)	184. (a)	185. (b)	186. (d)	187. (a)	188. (b)	189. (b)	190. (a)
191. (c)	192. (b)	193. (b)	194. (c)	195. (c)	196. (b)	197. (a)	198. (d)	199. (d)	200. (c)
201. (b)	202. (b)	203. (d)	204. (b)	205. (a)	206. (d)	207. (a)	208. (b)	209. (c)	210. (a)
211. (c)	212. (a)	213. (d)	214. (a)	215. (a)	216. (d)	217. (b)			

Explanations

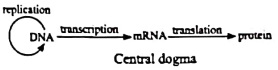
1. (a) In prokaryotes, such as, *E. coli*, though they do not have a defined nucleus, the DNA is not scattered throughout the cell. DNA (being negatively charged) is held with some proteins (that have positive charges) in a region termed as 'nucleoid'. The DNA in nucleoid is organised in large loops held by proteins.

2. (d)
A. Bacteriophage $\phi \times 174$ - (II) 5386 nucleotides
B. Bacteriophage Lambda - (I) 48502 base pairs
C. *Escherichia coli* - (IV) 4.6×10^6 base pairs
D. Haploid content of human DNA base pairs - (III) 3.3×10^9 base pairs

3. (c) Chargaff's rule states DNA has equal amounts of purines (adenine, guanine) and pyrimidines (thymine, cytosine), meaning the number of adenine equals thymine, and guanine equals cytosine.

4. (b) Length between two base pair = 0.34nm
Let us assume the total number of base pairs to be B.
Number of base pairs = Total length of DNA molecule / Distance between two base pairs
$= (1.1) / 0.34 \times 10^{-9}\ m = 3.3 \times 10^9$ base pairs
Therefore, the approximate number of base pairs will be 3.3×10^9

5. (c) The chromatin that is more densely packed and stains dark are called as heterochromatin. It is transcriptionally inactive chromatin.
The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome. A typical nucleosome contains 200 bp of DNA helix.

6. (b) replication


Central dogma
Central dogma was proposed by Francis Crick according to which the genetic information transfers from DNA to RNA to Proteins. It starts with the replication of DNA, followed by the formation of mRNA through transcription. After that proteins are formed by the process of translation.

7. (b) According to Chargaff's rule, for a dsDNA,
$\frac{A+T}{G+C} = 1$ (constant)
Or, [A] = [T] and [G] = [C]
Adenine [A] = 30%
$A + T = 100 - [G + C] \Rightarrow 30 + 30 = 100 - [2G]$
$\Rightarrow 2G = 100 - 60 \Rightarrow G = 20$
Thus, [A] = [T] = 30 %
and, [G] = [C] = 20 %

8. **(a)** Eukaryotes have a set of positively charged, basic proteins called histones. Histones are rich in the basic amino acids namely lysine and arginine.

9. **(d)** Adenine forms complementary pair with thymine by forming two hydrogen bonds.

10. **(b)** Given that,

Distance between two consecutive base pairs= 0.34 nm = 0.34×10^{-9} m

Total number of base pairs= 6.6×10^{9} bp

Length of DNA = Distance between two consecutive base pairs x Total number of base pairs

$= [0.34 \times 10^{-9}] \text{ m} \times 6.6 \times 10^{9} \text{ bp} = 2.2 \text{ m}$

11. **(c)** A nitrogenous base is linked to the pentose sugar through a N-glycosidic linkage to form a nucleoside. The nitrogenous bases are purines or pyrimidines. Nitrogen base is attached to the C-1 of the pentose sugar.

12. **(d)** *E. coli* that has only 4.6×10^{6} bp completes the process of replication within 18 minutes; that means the average rate of polymerisation has to be approximately 2000 bp per second.

13. **(b)** Adenine and guanine are the purines found both in DNA and RNA.

14. **(c)** The association of H_1 protein indicates the complete formation of nucleosome. Therefore, the DNA is in condensed form

15. **(b)** DNA fragments are negatively charged because of phosphate group.

16. **(b)** The genome is described as the genetic information repository of an organism. The genetic material, i.e., DNA is packaged into thread-like structures called chromosomes. Gene is the segment of DNA that codes for the protein. Nucleotide is the building block of genetic material. Therefore, the correct order of organisation is:

Genome - Chromosome - Gene - Nucleotide

17. **(d)**

Replication

DNA $\xrightarrow{\text{Transcription}}$ mRNA $\xrightarrow{\text{Translation}}$ protein

Fig: Central Dogma

Central Dogma; proposed by Francis Crick.

18. **(d)** Nucleosomes contains octameric histones (H_2A, H_2B, H_3, H_4).

19. **(c)** Retrovirus (HIV) has reverse transcriptase which makes them enable to follow reverse of central dogma.

20. **(c)** Two nucleotide are held together by phosphodiester linkage.

21. **(d)** Gene is segment of DNA which acts as an instrument for synthesis of protein. The DNA sequence coding for tRNA or rRNA molecule also define a gene.

22. **(b)** In a DNA molecule, the two polynucleotide chains are antiparallel. This means that one with polarity 5' - 3' while another with 3' - 5' polarity. Amount of purine and pyrimidine nucleotides is always equal.

23. **(b)** Two polynucleotide chains in DNA are antiparallel; one with polarity 5' - 3' while another with 3' - 5' polarity.

24. **(b)** The negatively charged DNA is wrapped around the positively charged histones octamer, supercoiled to form nucleosomes (monomer of chromatin).

25. **(d)** DNA double helix elucidated by Watson and Crick in 1953. The antiparallel strands of DNA molecule means that the phosphate groups at the start of two DNA strands are in opposite position.

26. **(b)** Guanine pairs with cytosine and they are equal to each other likewise, adenine pairs with thymine (A = T). Therefore, the ratio of G + C : A + T is always a constant according to Chargaff's rules.

27. **(c)** In most eukaryotic chromosome, telomere DNA sequences are arrays of short G - rich repetitive sequences that terminate in 3'-single strand. Guanine rich overhang is synthesised by telomere specific reverse transcriptase called telomerase.

28. **(c)** There are 4 bases : Adenine (A), Guanine (G), Cytosine (C) & Thymine (T)

$A + G + C + T = 100\%$ ...(1)

Acc. to Chargaff's rule, purines is equal to pyrimidines:

$A + G$ (purines) $= C + T$ (pyrimidines) ...(2)

Putting (2) in (1)

$C + T + C + T = 100\%$

$2C + 2T = 100\%$

$2C + 40\% = 100\%$ (Given, Thymine is 20%)

$2C = 60\%$

$C = 30\%$

Guanine base pairs with cytosine, hence percentage of cytosine is equal to guanine, i.e., 30%

29. **(a)** Distance between 2 base pairs is 0.34 nm and each loop of B-DNA has approximately 10 base pairs, hence the length of loop turns out to be 3.4 nm.

30. **(a)** Human genome contains approximately 3 billion (3×10^{9}) base pairs, which is in 23 pairs of chromosomes.

31. **(b)** Genes are composed of nucleotides linked together by phosphodiester bonds.

32. **(a)** In yeast, the molecular weight of DNA is 2.56×10^{7} Daltons.

33. **(a)** Histones are basic proteins found in eukaryotic chromosome. Prokaryotic DNA is non - histonic.

34. **(d)** DNA contains gene & are supercoiled to form chromosome. These DNA molecules are acidic in nature due to presence of negative charge of phosphates. Therefore, proteins that are basic in nature bind to DNA & help them in super coiling. Histones are also basic proteins present in eukaryotes.

35. **(a)** Centromere is a region of chromosome to which the microtubules of spindle is attached during cell division. It, moreover, links a pair of sister-chromatids in a chromosome.

36. **(d)** Nucleosome core is made up of H_2A, H_2B, H_3 and H_4. It is about 7-10 nm in diameter, consisting of histones around which a DNA strand, about 120 base pair long is wrapped in chromosomes.

Nucleosome core is consists of a histone octamer, which has two copies of each of the four core histone proteins - H_2A, H_2B, H_3 & H_4.

37. **(b)** Avery, Macleod & McCarty demonstrated that DNA is the substance that causes bacterial transformation.

38. **(a)** In double stranded DNA, two strands of DNA are complementarily base paired and, according to Chargaff's rules, will have equal nitrogeneous bases, whereas in ssDNA there is no relation among the percentage of nitrogeneous bases.

39. **(a)** X-ray crystallography shows an exceptionally clear diffraction pattern of a crystallised molecule. Rosalind Franklin used this technique to figure out the structural information of DNA.

40. **(d)** According to Chargaff's rules, the amount of adenine is always equal to that of thymine, and the amount of guanine is always equal to that of cytosine, i.e., A = T (120) and G = C (120), therefore, the total number of nucleotides would be $120 \times 4 = 480$.

41. **(b)** Nucleosome is highly coiled form of DNA around the histone protein core. 4 type of histones - two dimers of H_2A & H_2B and two molecules each of H_3 & H_4 combines together to form octamer protein complex.

42. **(c)** According to Chargaff's rules, ratio of pyrimidine and purine should be 1 : 1 in cells of all organisms, i.e., the amount of guanine should be equal to cytosine and amount of adenine to thymine.

43. **(a)** Humans have 23 pairs of chromosomes, i.e., 46 chromosomes in a diploid cell.

44. **(d)** DNA molecule consists of two strands that wind around each other like a twisted ladder. These strands are associated with some basic proteins that provide the structure with stability.

45. **(c)** The unequivocal proof that DNA is the genetic material came from the experiments of Alfred Hershey and Martha Chase (1952). They worked with viruse that inject bacteria called bacteriophages.

46. **(b)** RNA mutates at a faster rate because it is unstable. Therefore, viruses having RNA genome and shorter life span allow them to mutate and evolve at faster rates.

47. **(b)** A. D Hershey and M.J. Chase

The scientists who used ^{32}P and ^{35}S labelled phages to demonstrate that DNA is the genetic material were Alfred Hershey and Martha Chase. Their experiment conclusively showed that DNA, not protein, is the molecule of inheritance.

48. **(c)** Both Statement-I and Statement-II are correct.

RNA being unstable tends to mutate quickly. RNA's ability to directly code for proteins allows for rapid expression of genetic information.

49. **(b)** (A) and (B) only

The Hershey and Chase experiments demonstrated that DNA is the genetic material, not protein. Viruses grown in the presence of radioactive phosphorus had radioactive DNA, and those grown on radioactive sulphur had radioactive proteins.

50. **(d)** If DNA contained sulphur instead of phosphorus and proteins contained phosphorus instead of sulphur, the outcome of the Hershey and Chase experiment would still be radioactive sulphur in bacterial cells.

51. **(d)** The bacterium *E. coli* can divide in every 20 min. In other words, after every 20 minutes, the number of cells becomes doubled. When ^{15}N-dsDNA is incubated in medium containing ^{14}N nucleotide, the first generation has intermediates only ($^{15}N^{14}N$). Second generation (after 20 minutes) will produce two hybrid strands, i.e., $^{15}N^{14}N$ in equal proportion, so the ratio is 1:1. Third generation (after 20 minutes) will produce 2 hybrid strands and 2 light strands containing 14N only. Fourth generation (after 20 minutes) will produce 2 hybrid strands and 6 light strands. So, after 60 minutes there will be 6 light strands totally free from ^{15}N.

Total number of *E.coli* cells = 6 × 10 cells = 60 cells.

52. **(a)** DNA as an acidic substance present in nucleus was first identified by Friedrich Meischer in *1869*. He named it as 'Nuclein'.

53. **(b)** Semiconservative mode of DNA replication was performed by Meselson and Stahl in their experimental proof. They labeled the DNA of bacteria across generations using isotopes of nitrogen.

54. **(a)** Ribozymes are ribonucleic acids (RNAs) that act as an enzyme and catalyse the biochemical reactions.

55. **(b)** Hershey and Chase gave unequivocal proof that DNA is genetic material.

56. **(a)** A molecule that can act as a genetic material must fulfill the following criteria:
(i) It should be able to generate its replica (replication).
(ii) It should chemically and structurally be stable.
(iii) It should provide the scope for slow changes (mutation) that are required for evolution.
(iv) It should be able to express itself in the form of 'Mendelian Characters'.

57. **(d)** Taylor and colleagues in 1958 with the help of radioactive thymidine detect distribution of newly synthesised DNA in the chromosomes. The experiment was performed on *Vicia faba* (Faba beans). The experiments proved that the DNA in chromosomes also replicate semi-conservatively.

58. **(a)** The ribosome also acts as a catalyst (23S rRNA in bacteria is the enzyme- ribozyme) for the formation of peptide bond.

59. **(a)** $\frac{A+T}{G+C}$ = constant (Chargaff Rule)

Guanine = Cytosine

Cytosine = 17%

$A + T = 100 - [G + C]$

$= 100 - [17 + 17]$

$A + T = 66$

Adenine = Cytosine

$T = A = 33\%$

60. **(c)** Erwin Chargaff made observations on the base and other DNA contents.

Adenine + Guanine = Thymine + Cytosine

$\frac{A+T}{G+C}$ = Constant for a species

61. (d) Transformation was discovered by Griffith.

62. (b) The unequivocal proof that DNA is the genetic material came from the experiments of Alfred Hershey and Martha Chase (1952).They used *bacteriophage* (bacterial virus) and *E.coli*.

63. (d) Nirenberg and Matthaei were able to synthesise artificial mRNA. During the process, a small polypeptide molecule was produced by linking of phenylalanine. They got Nobel Prize for this discovery.

64. (b) Transformational experiment, also called Griffith's experiment, was done in 1928 by Frederick Griffith to show that bacteria can get DNA through transformation process. He used two strains (R & S) of bacteria *Streptococcus Pneumoniae*.

65. (a) DNA is a polymer of deoxyribonucleotides and RNA is a polymer of ribonucleotides.

66. (a) Thymidine incorporation assay is the most common assay to determine the rate of DNA synthesis in which a radioactive nucleoside 3H - thymidine is incorporated into new strands of chromosomes DNA.

67. (c) Autoradiography is the study of labelled precursors like ^{3}H by knowing the movement of radioactivity with the help of photographic films and emulsions at short intervals. ^{14}C and ^{3}H are incorporated in bases like thymidine, uridine and amino acids to study the structure of DNA and proteins. Radiotracer technique shows that DNA is in double helical form.

68. (d) Hershey - Martha Chase experiment (1952) convinced the world that DNA was the genetic material. They showed that when bacteriophages infect bacteria, their DNA enters the host bacterial cell.

69. (a) Meselson & Stahl labeled the DNA of *E.coli* using isotopes of nitrogen for several generations to study the DNA replication and its mode. Khorana, together with Robert Holley & Marshall Nirenberg received the nobel prize for their work on deciphering genetic code. He used both enzymatic & chemical synthesis of oligonucleotides to decipher many codes including cysteine & valine.

70. (a) Two strands of DNA of first generation bacteria are semi-conservatively replicated, i.e., one strand is newly formed (N^{14}) & another is parental inherited strand (N^{15}). Thus, they will have different density.

(b) DNA polymerases catalyze nucleotide addition or polymerisation only in the 5' to 3' direction. Replication is continuous on the leading strand and discontinuous on the lagging strand.

(d) In replication, on one strand (the template with polarity 3' → 5'), the replication is continuous and is called leading strand. On the other strand (the template with polarity 3' → 5'), the replication is discontinous and is called as lagging strand. The short, newly synthesised DNA fragments (Okazaki fragments) are used to elongate the lagging strand away from the replication fork.

73. (b) RNA polymerase catalyses the RNA synthesis in 5' → 3' direction. Direction of reading of DNA template strand in 3' → 5'.

74. (c) During replication there is discontinuous synthesis at the lagging strand which has polarity 5' - 3'. DNA polymerase synthesises in 5' → 3' direction.

75. (c) In bacteria, DNA replication proceeds with two replication forks moving in opposite directions around circular chromosome called bidirectional replication.

76. (b) One strand would be radioactive explaining the semi-conservative nature of DNA replication as explained in Meselson-Stahl's experiment.

77. (c) Semiconservative mode of DNA replication produces two copies of DNA, each contained one of the original strands and one new strand.

78. (c) Each bacterial cell divides in 35 minutes, i.e., in 175 minutes, 5 cycles of division will take place.

At t = 0, bacterial cells = 1×10^5

At t = 35 minutes, no. of bacteria = 2×10^5

At t = 175 minutes, bacterial cells = $2^5 \times 10^5 = 32 \times 10^5$

79. (b) DNA is a double helical molecule and it opens to form a replication fork for its replication. The two strands of DNA are joined with the help of H-bonds between the strands. Topoisomerases are specialised to cause nicks or breaks in the double helix and helps separate the DNA stands. Helicase unwinds the DNA helix from that nick caused by the topoisomerase and this separates the two strands.

DNA gyrase introduces negative supercoils in DNA strands of prokaryotes.

DNA polymerase adds nucleotides units to the 3' end of a DNA chain. DNA ligase joins the ends of DNA.

80. (c) DNA gyrase catalyses the ATP - dependent negative supercoiling of ds DNA. They belongs to a class of enzyme known as topoisomerase. They relieves strain while ds DNA is being unwound by helicase.

81. (b) Proved by Meselson - Stahl experiment, the DNA replication is semi - conservative (one parental strand is conserved and other is newly formed) and semi - discontinuous.

82. (c) In eukaryotes, The RNA polymerase I transcribes rRNAs (28S, 18S, and 5.8S), whereas the RNA polymerase III is responsible for transcription of tRNA, 5srRNA, and snRNAs (small nuclear RNAs). The RNA polymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).

83. (d) The two strands have opposite polarity and the DNA-dependent RNA polymerase also catalysed the polymerisation in only one direction, i.e., 5'-3', The strand that has the polarity 3' - 5' acts a template, and is also referred to as template strand. The other stand which has polarity (5'- 3') and the sequence same as RNA (except thymine at the place of uracil), is displaced during transcription. This strand is referred to as coding strand.

84. (c) Both Statement I and Statement II are true.

Transcription involves copying genetic information from DNA to RNA, and a transcription unit in DNA is defined by a promoter, a structural gene, and a terminator.

85. (a) RNA polymerase III is responsible for transcription of tRNA, 5srRNA and snRNA

RNA polymerase II is responsible for transcription of mRNA precursor, the heterogenous nuclear RNA (hnRNA).

RNA polymerase I is responsible for transcription of 28S, 18S and 5.8S rRNA.

86. (a) The RNA polymerase binds with sigma factor (σ) for initiation and with rho factor (ρ) for termination of transcription.

Template strand (non-coding strand) is copied to mRNA.

In eukaryotes, the monocistronic structural genes have interrupted coding sequences (exons) thus the genes in eukaryotes are split.

87. (a) In prokaryotes, single DNA-dependent RNA polymerase catalyses initiation, elongation and termination in the process of transcription.

DNA ligase facilitates the joining of the fragments of DNA.

DNase is an endonuclease enzyme which catalyses the breakdown of single- or double stranded DNA. DNA dependent RNA polymerase cayalyses polymerization of DNA during replication of DNA.

Capping of methyl guanosine triphosphate takes place at 5' end of hnRNA.

88. (c) During transcription, RNA polymerase facilitates the opening of the DNA helix and continues elongation.

89. (a) Non-coding or template strand codes for mRNA which is complementary to coding strand. So, mRNA is identical to coding stand, except it has uracil (U) in place of thymine (T).

90. (d) Spliceosomes are used in removal of introns during post-transcriptional processing of hnRNA in eukaryotes only, as split genes are absent as in prokaryotes.

91. (a) rRNA is most abundant in animal cell. It constitutes 80% of total RNA of the cell.

92. (c) DNA-dependent RNA polymerase catalyses transcription on one strand of the DNA is called the template strand.

93. (b) The promoter and terminator flank the structural gene is a part of transcription unit.

94. (a) The primary transcripts contain both the exons and the introns and are non-functional. Removal of introns and joining of exons in a defined order during transcription in called splicing.

95. (a) The ribosome also acts as a catalyst (23S rRNA in bacteria is the enzyme-ribozyme) for the formation of peptide bond.

96. (a) In transcription, RNA splicing and RNA capping takes place inside the nucleus.

97. (a) Splicing is a process of removal of introns and joining the exons in a defined order in a transcription unit.

98. (b) Transcription factor is the molecular basis to tissue differentiation..

99. (b) It is a 7 b.p long region located 20 b.p upstream to the start point. During transcription, RNA polymerase binds to TATA box due to which DNA assumes a saddle like structure.

100. (b) mRNA is complementary to DNA template strand and has uracil in place of thymine. So, UAUGC is complementary nucleotide sequence on mRNA transcript for ATACG of DNA strand.

101. (d) Mutation in genetic code results in changes in the protein sequence during translation. Based on the difference in this sequence of amino acids, every protein takes different structure.

102. (a) In order to start the transcription of a DNA strand, the core RNA polymerase bind at the promoter, specific DNA sequence that are required for transcription initiation.

103. (a) UAA is a stop codon and so it will terminate the translation after 24 and 24 amino acids long polypeptide chain is formed.

104. (a) Exons, also called coding sequences of mRNA, codes for polypeptide chain of amino acids, i.e., proteins.

105. (c) RNA ligase catalyses the ligation of RNA molecules by forming phosphodiester bonds between single stranded RNA containing 5' - PO_4^{3-} & 3' - OH termini.

106. (c) In eukaryotes, RNA polymerase I synthesises 45S, pre-rRNA RNA polymerase II synthesises precursor of mRNA and most snRNA and RNA polymerase III synthesises tRNA, 5S rRNA and other small RNAs found in nucleus and cytosol.

107. (a) During transcription, RNA polymerase read template strand of DNA in 3' →5' direction & mRNA formed is complementary in 5' → 3' direction.

108. (d) Exons are decoded to produce proteins. These proteins and their concentration determine the formation of organs and its regulation.

109. (d) AUG codon is called the start codon and is first codon transcribed in mRNA that undergoes translation.

110. (b) Point mutation occurs by change in only one or very few nucleotides in a gene sequence.

111. (b) Regulatory gene controls the expression of a gene during its transcription.

112. (a) Transposons, also called jumping genes, is a sequence of DNA that can change its position within a genome, creating or reversing the mutations. First identified by Barbara McClintock.

113. (d) Nucleolus is a plasmosome body that is formed around the nucleolus organiser and is located in the secondary constriction on that chromosome. It is made up of RNA and proteins. The associated nucleolar chromatin contains DNA. It forms mRNA that has low molecular weight. Ribosomes are mainly concerned with proteins synthesis. They are sites for synthesis of rRNA and tRNA is synthesised in the cytoplasm.

114. (d) Bases sequence in transcript will be complementary and thymine will be replaced by uracil in transcript. So, the sequence complementary to ATTCGATG will be UAAGCUAC.

115. (a) Insertion of cytosine base will shift the frame of codons and it will result into CAT GAT GATG frame.

116. (a) Exons are the part of gene that encodes final mature mRNA and is generally called coding sequence of DNA in contrast to non-coding sequences introns.

117. **(a)** Anticodon is three nucleotide sequence at one end of tRNA that forms 3 complementary base pairs with a codon in mRNA.

118. **(b)** Process of formation of mRNA transcript from the template strand of DNA by RNA polymerase is called reverse transcription. It takes place in nucleus of the cell.

119. **(b)** Sickle cell anaemia

Sickle-cell anaemia is an autosome linked recessive disorder caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule.

120. **(d)** (A) and (C) only

Sickle cell anaemia is caused by a point mutation in the gene encoding the beta-globin chain of haemoglobin. Specifically, glutamic acid is replaced by valine at the sixth position, not lysine.

121. **(d)** (C) and (D) only

The genetic code has several key features, including being unambiguous and specific and is nearly universal.

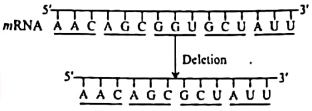
122. **(a)** mRNA codon : 5' UAC 3'

tRNA Anticodon : 3' AUG 5'

The sequence of anticodon on tRNA would be 5 GUA 3

123. **(c)** The codon AUG has dual functions. It codes for methionine (Met) and also acts as initiator codon. The codon UUU and UUC codes for phenylalanine (Phe).

. **(d)** A base insertion or deletion will not shift the reading frame if it is in a multiple of three



No change in reading frame of *m*RNA.

(c) In recombinant DNA technology, bacteria is able to produce human insulin because genetic code is nearly universal.

126. **(c)** Given: 999 bases = 900 bases + 99 bases

This means 333 codons = 300 codons + 33 codons

(∵sum of 3 bases = 1 codon)

When the base at position 901 gets deleted, change never happens in the 900 bases but only in the last 99 bases.

Thus, the number of unaltered codons = 300 codons

The number of altered codons = 33 codons.

127. **(a)** AUG has dual functions. It codes for methionine (met), and it also act as initiator (Starter) codon.

128. **(a)** Genetic code is universal, degenerate, unambiguous and read in contiguous manner.

129. **(d)** Change in single base pair of DNA is called point mutation. (E.g., Sickle cell anemia)

130. **(c)** Genetic code is universal, degenerate, unambiguous and contiguous.

131. **(a)** It involves mRNA silencing in which there is synthesis of two RNA molecules which are complementary to each other to form dsRNA that binds to and prevents translation of the mRNA.

132. **(d)** Stop codon; UAA, UAG, UGA

(Ochre) (Amber) (Opal)

133. **(b)** Transition is a point mutation in which purine replaces purine (A↔G) or a pyrimidine nucleotide replace pyrimidine (C↔T).

134. **(c)** Each codon is composed of 3 nucleotide and our genome has 4 types of nucleotide (A,T,G,C) so there are $4^3 = 64$ possible codons to code for all 20 amino acids.

135. **(d)** "Degenerate" simply refers to the fact that the translation from nucleotide codons to amino acids isn't one to one. Some parts of genetic code are redundant. It is mostly the third member of a codon that contributes to degeneracy of genetic code.

136. **(d)** AUG - start codon; UAG, UGA, UAA - stop codon; UGU codes for cysteine and UAC codes for tyrosine amino acid.

137. **(a)** H.J. Muller, an American geneticist, was awarded Nobel prize in 1946 for his contribution on radiation genetics by inducing sex-linked recessive lethal mutations in *Drosophila* using X - rays.

138. **(a)** Genetic code degeneracy is redundancy of the genetic code, i.e., multiple 3 base pairs codes for one amino acid e.g., UUA, UUG, CUU, CUC, CUA & CUG all codes for amino acid leucine.

139. **(b)** Mutation is alteration of nucleotide sequence of genome of an organism. It refers to the changes that occurs in DNA sequence due to mistakes during replication of DNA or due to any other mutagen present in environment.

140. **(b)** Mostly the mutations of genes are recessive and wild type is dominant, and mostly mutation causes disease and therefore, is harmful.

141. **(c)** AUG is the start codon that codes for amino acid methionine.

142. **(d)** Due to degeneracy of genetic code, it is not necessarily important that change in one base pair will lead to change in amino acid sequence or phenotype.

143. **(d)** 5-Bromouracil is an analog of thymine, that pairs with adenine. It induces point mutation by intercalating into the DNA and shift the frame of codons.

144. **(c)** Reciprocal translocation involves breakage of two non-homologous chromosome with exchange of fragments (chromosome number remains same). The association of 2 or more homologous chromosome during first division of meiosis results in multivalent chromosomes.

145. **(d)** Evolutionary changes and variation in a population of organisms is the result of accumulation of mutations.

146. **(b)** UAA, UAG & UGA are stop codons that causes the termination of a polypeptide chain during translation. They do not code for any amino acids.

147. **(a)** AUG codes for methionine that serves as an initiation codon. UAA, UAG and UGA are the three termination codons. AGA codes for arginine and GCG codes for alanine.

148. **(d)** Hermann Joseph Muller conducted three experiments to demonstrate that exposure to X-rays can cause genetic mutations.

149. **(c)** AUG is an initiation codon.

150. **(d)** AUG is the first codon that is transcribed during translation. It is called start or initiation codon.

151. **(c)** Degeneracy of genetic code explains that 64 codons are decoded to produce only 20 amino acids, i.e., more than one codon codes for one specific amino acid.

152. **(b)** Cysteine and valine

153. **(d)** Genetic code is triplet, i.e., 4 nitrogeneous bases are forming triplets to code for amino acids. $4^3 = 64$ possible codons are there.

154. **(d)** Genetic code consist of all the four nitrogeneous bases arranged as triplets, adenine, guanine are purines & cytosine, thymine, uracil are pyrimidines of nitrogeneous base.

155. **(b)** The cellular factory responsible for synthesising proteins is the ribosome. The ribosome consists of structural RNAs and about 80 different proteins.

156. **(b)** Translation refers to the process of polymerisation of amino acids to form a polypeptide. Ribosome is the cellular factory responsible for synthesis of proteins. The ribosome consists of structural RNAs and about 80 different proteins. In its inactive state, it exists as two subunits; a large subunit and a small subunit. When the small subunit of ribosome encounters an mRNA, the process of translation of the mRNA to protein begins.

157. **(c)** For the synthesis of protein, i.e., transcription process in prokaryotes (bacteria), three major types of RNAs are needed.

These are mRNA (messenger RNA), tRNA (transfer RNA), and rRNA (ribosomal RNA).

158. **(b)** In the first phase of translation, amino acids are activated in the presence of ATP and linked to their cognate tRNA – a process commonly called as charging of tRNA or aminoacylation of tRNA.

159. **(b)** Transcription → writing information from DNA to mRNA.

160. **(b)** RNA polymerase III is responsible for transcription of tRNA, 5SrRNA, and snRNAs (small nuclear RNAs).

161. **(c)** In RNA, uracil (U) is present in place of thymine. Therefore, adenine base pairs with uracil. Hence, the complementary RNA strand sequence will be UAGAG

162. **(b)** Neomycin → Inhibits interaction of tRNA with m - RNA

Streptomycin → Inhibits initiation of translation causing misreading

Tetracycline → Inhibits binding of aminoacyl - tRNA to ribosome

Erythromycin → Inhibits translocation of mRNA along ribosome

163. **(c)** During translation, t-RNA read the amino acid sequences of m- RNA (codon) with the help of anticodon loop of itself.

164. **(c)** tRNA molecule has a distinctive folded structure with three hairpin loops that form a shape of three-clover leaf. It is an adaptor molecule composed of RNA and has one anticodon loop that decodes transcript and has one amino acid attached to its end.

165. **(c)** The mRNA, small ribosomal subunit (30S) and tRNA-formyl-methyl together forms the initiation complex. GTP serves as a source of energy. GTP is required by the initiation factor - 2, they together bind to 30S and assist in binding of the initiator tRNA (formyl-methyl tRNA).

166. **(a)** tRNA has an anticodon loop that is required to read and decode the mRNA. Bases present on this anticodon loop pairs with the codons on mRNA and joins specific amino acid to growing polypeptide chain.

167. **(a)** Cloverleaf structure of tRNA becomes the 3D L-shaped structure through co-axial stacking of helices.

168. **(d)** tRNA helps decoding mRNA sequence into a protein. They act as temporary carriers of amino acids, bringing the specific amino acids to the ribosomes based on the mRNA nucleotide sequence.

169. **(a)** Peptidyl transferase reaction is carried out by the ribosome, in which peptide bonds are formed between adjacent amino acids using tRNAs.

170. **(d)** The protein synthesis occurs in three steps: initiation, elongation and termination. Transcription is the process of mRNA synthesis.

171. **(b)** Translation is a complex process of protein synthesis that is directed by a mRNA template. Sequence of nucleotides on mRNA is translated into amino acids sequence.

172. **(c)** The *lac* operon consists of one regulatory gene (the *i* gene – here the term *i* does not refer to inducer, rather it is derived from the word inhibitor) and three structural genes (*z*, *y*, and *a*). The *i* gene codes for the repressor of the *lac* operon. The *z* gene codes for beta-galactosidase (β-gal), which is primarily responsible for the hydrolysis of the disaccharide, lactose into its monomeric units, galactose and glucose. The *y* gene codes for permease, which increases permeability of the cell to β-galactosides. The *a* gene encodes a transacetylase.

173. **(c)** Repressor protein.

The repressor protein binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon.

174. **(b)** Lactose

Lactose acts as an inducer for the *lac* operon by binding to the repressor.

175. **(b)** In the *lac* operon, the *z* gene codes for β-galactosidase, an enzyme that catalyses the hydrolysis of lactose into glucose and galactose.

176. **(c)**

A. In *lac* operon *i* gene codes for - (IV) Repressor

B. In *lac* operon *z* gene codes for - (III) β-galactosidase

C. In *lac* operon *y* gene codes for- (II) Permease

D. In *lac* operon *a* gene codes for - (I) Transacetylase

177. (d) The lac operon consists of one regulatory gene (*i* gene) and three structural genes (*z*, *y*, and *a*). The i gene codes for the repressor of the lac operon. Since, the i gene is mutated, it is unable to code for the repressor. The repressor will not be able to bind to the inducer molecule and therefore, the structural genes, *z*, *y*, *a* will not be translated.

178. (c) In lac operon, the respective codes for the following:

i gene — Repressor

z gene — β-galactosidase

y gene — Permease

a gene — Transacetylase

179. (d) Lac Operon was studied and discovered by Jacob and Monod to determine how a cell knows which enzyme to synthesise. This discovery won them Noble Prize.

Alec Jeffrey - DNA fingerprinting; Hershey and Chase - Blender experiment to proof DNA is the genetic material; and Meselson and stahl - Semiconservative mode of replication.

180. (c) Enhancer is a short region of DNA that can be bound by activators (proteins) to increase the chances of transcription of a particular gene.

181. (d) The equivalent of a structural gene is cistron.

Cistron: A segment of DNA coding for a polypeptide

182. (d) Inducible operon system regulates genetic material which remains switched off normally but becomes operational in the presence of inducer. E.g., Lac operon transcription is under negative control when lac repressor is inactivated by inducer.

183. (b) The *lac Y* gene codes for permease, which increases permeability of the cell to β-galactosides. A non-sense mutation in Y-gene causes generation of a non-functional permease.

184. (a) B: Negative regulation, C: Approx 30,000 genes.

185. (b) Lactose is the exclusive preferred carbon source. Glucose or galactose cannot act as inducers for lac operon. 'Z' gene code for β-galactosidase. Lac operon elucidated by Jacob and Monod.

186. (d) Lac operon consists of one regulatory gene and three structural genes (*z*, *y* and *a*)

187. (a) Differentiation of organs and tissues in a developing organism, is associated with differential gene expression.

188. (b) Steroid hormone receptor protein complex activate transcription of target gene by binding to specific DNA sequence.

189. (b) Z gene codes for β-galactosidase which breaks lactose into glucose and galactose to be utilised in the cell. Therefore *E. coli* cells with mutated Z genes of the lac operon cannot grow in medium containing only lactose since they can't synthesise functional β-galactosidase.

190. (a) Lac refers to lactose, as lactose acts as an inducer to control the expression of lac operon genes.

191. (c) An operon is a functioning unit of DNA containing a cluster of genes under the control of a single promoter. Originally they were thought to exist solely in prokaryotes but evidences have arised to show their existence in eukaryotes. Expression of prokaryotic operons lead to polycistronic mRNAs, while eukaryotic operons lead to monocistronic RNAs.

192. (b) In the absence of lactose, the lac repressor protein binds to the operator and blocks transcription of lac-operon genes.

193. (b) In negative inducible operons, repressor binds to the operator and prevents the transcription of genes on operon. Co-repressor is the activating ligand of a repressor protein.

194. (c) Cistrons are coding genes. One cistron has one coding gene that codes for one protein.

195. (c) Regulatory gene is involved in controlling the expression of genes by producing a repressor that binds to an operator and regulates the gene expression.

196. (b) Cytoplasmic male sterility is caused by extranuclear genome (mitochondria or chloroplast) & shows maternal inheritance.

197. (a) When *E.coli* bacteria are transferred to medium containing lactose, then the lac operon is induced. The lac operon consists of 3 structural gene (*lac z*, *lac y* and *lac a*). It involves the synthesis of β-galactosidase enzyme in *E. coli*, which hydrolyses lactose into glucose and galactose.

198. (d) In *lac* operon (here *lac* refers to lactose), a polycistronic structural gene is regulated by a common promoter and regulatory genes. Such arrangement is very common in bacteria and is referred to as operon.

199. (d) Inducer is a metabolite (or analogue of similar chemical structure), usually of low molecular weight, which promotes the production of an enzyme. Inducers are often substrates for the enzymes they induce, e.g., lactose in case of synthesis of β-galactosidase in *lac* operon.

Inducer can bind to repressor or activator proteins of a particular operon and regulates the gene expression. It binds to the repressor and triggers the expression of genes.

200. (c) β -galactosidase is an intracellular enzyme that cleaves lactose into glucose & galactose. In the absence of lactose, lac repressor binds DNA and represses transcription.

201. (b) All the genes that are expressed as RNA are referred to as Expressed sequence Tags (EST) are focussed on identifying all the genes that are expressed as RNA.

202. (b) Chromosome 1

The last chromosome sequenced in the Human Genome Project was chromosome 1 which has the most no. of genes (2968).The sequence of chromosome 1 was completed only in May 2006.

203. (d) DNA polymorphism refers to the variation in DNA arising through mutation at non-coding sequences. Polymorphism in DNA sequence is the basis of genetic mapping of human genome as well as of DNA fingerprinting.

204. (b) If a geneticist uses the blind approach of sequencing the whole set of genome that contained all the coding and non-coding sequence, and later assigning different regions in the sequence with functions, the methodology adopted by him is referred to as Sequence Annotation.

For sequencing, the total DNA from a cell is isolated and converted into random fragments of relatively smaller sizes and cloned in suitable host using specialised vectors. The cloning resulted into amplification of each piece of DNA fragment so that it subsequently could be sequenced with ease.

205. (a) DNA fingerprinting involves identifying differences in specific region in the DNA known as Repetitive DNA because in these sequences, a small stretch of DNA is repeated many times.

The bulk DNA which leads to the formation of major and small peaks is called Satellite DNA. These sequences normally do not code for any proteins. These sequences show high degree of polymorphism and form the basis of DNA fingerprinting.

206. (d) DNA fingerprinting is a technique to find out variations in individuals of a population at DNA level. It works on the principle of polymorphism in DNA sequences. It has immense applications in the field of forensic science, genetic biodiversity and evolutionary biology.

207. (a) Expressed Sequence Tags (ESTs) are DNA sequences (genes) that are expressed as mRNA for protein synthesis. These are used in Human Genome Project.

208. (b) Zinc finger analysis is not required for any of the techniques of DNA fingerprinting available at present.

209. (c) Glucose or galactose cannot act as inducers for lac operon. Regulation of lac operon by repressor is referred to as negative regulation.

210. (a) Polymorphism: Variations at genetic level arisen due to mutations is called polymorphism. These variations occur in non-coding regions of DNA and do not code for any protein but are heritable. The polymorphism in DNA is the basis of genetic mapping and DNA fingerprinting.

211. (c) Commonly used vector for HGP are bacterial artificial chromosome (BAC) and yeast artificial chromosome (YAC).

212. (a) PCR is not involved in southern hybridisation.

213. (d) Satellite DNA do not code for any protein, but they show high degree of polymorphism and form basis of DNA fingerprinting.

214. (a) The sensitivity of the genetic fingerprinting technique has been increased by use of polymerase chain reaction & Restriction Fragment Length Polymorphism (RFLP)

215. (a) HGP was closely associated with the rapid development of a new area in biology called as bioinformatics.

216. (d) DNA fingerprinting is a method used to identify an individual from a sample of DNA by looking at unique patterns in their DNA.

217. (b) Mitochondrial DNA can be inherited only from mother and Y-chromosome is inherited by male child from father. These two parts of human genome are inherited uniparentally, show fast mutation rate and do not recombine, thus, are used to study human evolution.

CHAPTER 6

Evolution

Origin of Life & Theories of Evolution

1. Panspermia, an idea that is still a favourite for some astronomers, means *(2022 Rc)*
   a. Transfer of spores as unit of life from other planets to Earth
   b. Creation of life from dead and decaying matter
   c. Creation of life from chemicals
   d. Origin of sperm in human testes

2. From his experiments, S.L. Miller produced amino acids by mixing the following in a closed flask: [MR*] *(2020)*
   a. CH_4, H_2, NH_3 and water vapor at 800°C
   b. CH_4, H_2, NH_3 and water vapor at 600°C
   c. CH_4, H_2, NH_3 and water vapor at 600°C
   d. CH_4, H_2, NH_3 and water vapor at 800°C

3. After about how many years of formation of earth, life appeared on this planet? *(2020-Covid)*
   a. 50 million years b. 500 million years
   c. 50 billion years d. 500 billion years

4. Which of the following is the correct sequence of events in the origin of life? *(2016 - II)*
   I. Formation of protobionts
   II. Synthesis of organic monomers
   III. Synthesis of organic polymers
   IV. Formation of DNA-based genetic systems
   a. II, III, I, IV b. II, III, IV, I
   c. I, II, III, IV d. I, III, II, IV

5. Following are the two statements regarding the origin of life: *(2016 - I)*
   A. The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
   B. The first autotrophic organisms were the chemoautotroph's that never released oxygen.
   Of the above statements which one of the following options is correct?
   a. (A) is correct but (B) is false
   b. (B) is correct but (A) is false
   c. Both (A) and (B) are correct
   d. Both (A) and (B) are false

6. Which one is correctly matched? [MR*] *(2009)*
   a. deVries - Natural selection
   b. Mendel - Theory of pangenesis
   c. Weismann - Theory of continuity of Germplasm
   d. Pasteur - Inheritance of acquired character

7. Which is incorrect about protobionts in abiogenic origin of life? *(2009)*
   a. They were partially isolated from surroundings
   b. They could maintain an internal environment
   c. They were able to reproduce
   d. They could separate combination of molecules from the surroundings

8. Concept of chemical evolution of life is based on: *(2007)*
   a. Effect of solar radiations on chemicals
   b. Interaction of water, air and clay under intense heat
   c. Combination of chemicals under hot moist environment conditions
   d. Crystallisation of chemicals

9. Which one is correct? *(2007)*
   a. There is no evidence of presence of gills in mammalian embryos
   b. Ontogeny repeats phylogeny
   c. All plant and animal cells are totipotent
   d. Stem cells are specialised cells

10. Evolutionary history of an organism is known as: *(2006)*
    a. Ontogeny b. Phylogeny
    c. Ancestry d. Paleontology

11. Which of the following amino acids was not found to be synthesised in Miller's experiment? *(2006)*
    a. Alanine b. Glycine
    c. Aspartic acid d. Glutamic acid

12. Which experiment suggests that simplest living organisms could not have originated spontaneously from non-living matter? *(2005)*
    a. Microbes did not appear in stored meat
    b. Microbes appeared from unsterilised organic matter
    c. Larvae could appear in decaying organic matter
    d. Meat was not spoiled when heated and kept in sealed vessel

13. According to Oparin, which one of the following was not present in the primitive atmosphere of the earth? *(2004)*
    a. Oxygen b. Hydrogen
    c. Water vapour d. Methane

14. Diversification in plant life appeared: [OS]*(2004)*
    a. Due to abrupt mutations
    b. Suddenly on earth
    c. By seed dispersal
    d. Due to long periods of evolutionary changes

15. Which one of the following sequences were proposed by Darwin and Wallace for organic evolution? *(2003)*
    a. Overproduction, variations, constancy of population size, natural selection
    b. Variations, constancy of population size, Overproduction, natural selection
    c. Overproduction, constancy of population size, variations, natural selection
    d. Variations, natural selection, overproduction, constancy of population size

16. There is no life on moon due to the absence of: *(2002)*
    a. O_2 b. Water
    c. Light d. Temperature

17. Living beings maintain continuity of life by: *(2000)*
    a. Adaptation
    b. DNA-replication and its transfer in next generation
    c. RNA synthesis
    d. None of the above

18. First life on earth was: *(2001)*
    a. Cyanobacteria b. Chemoheterotrophs
    c. Autotrophs d. Photoautotrophs

19. Half life period of C^{14} is: [OS] *(2001)*
    a. 500 years b. 5000 years
    c. 50 years d. 5×10^4 years

20. Due to discovery of which of the following in *1980*, the evolution was termed as RNA world? *(2001)*
    a. mRNA , tRNA, rRNA synthesise proteins
    b. In some virus RNA is genetic material
    c. RNA have enzymatic property
    d. RNA is not found in all cells

21. Which one is obtained by S. miller in his experiments on origin of life before 1953? *(1999)*
    a. Simple sugars b. Amino acids
    c. Nucleotide d. Peptides

22. Evolution of heart from one to two, three and four chambered proves: *(1998)*
    a. Biogenetic law of Haeckel
    b. Lamarckism
    c. Hardy Weinberg's law
    d. Neo Darwinism

23. In present times the origin of life is not possible from inorganic compounds due to: *(1998)*
    a. Raw material not available
    b. Highest conc. of O_2 in atmosphere
    c. Decrease in temperature
    d. Excess of pollution

24. The correct sequence for the manufacture of molecules/ organic compounds on the primitive earth is: *(1996)*
    a. NH_3, nucleic acid, protein and carbohydrate
    b. Protein, carbohydrate, water and nucleic acid
    c. NH_3, protein, carbohydrate and nucleic acid
    d. NH_3, water, nucleic acid and protein

25. The presence of gill slits, in the embryos of all vertebrates, supports the theory of: *(1995)*
    a. Metamorphosis
    b. Biogenesis
    c. Organic evolution
    d. Recapitulation

26. Which of the following evidences does not favor the Lamarckian concept of inheritance of acquired characters? *(1994)*
    a. Lack of pigment in cave-dwelling animals
    b. Melanisation in peppered moth
    c. Absence of limbs in snakes
    d. Presence of webbed toes in aquatic birds

27. The first organisms were: *(1992)*
    a. Chemoautotrophs b. Chemoheterotrophs
    c. Autotrophs d. Eucaryotes

28. Which was absent in the atmosphere at the time of origin of life? *(1991)*
    a. NH_3 b. H_2
    c. O_2 d. CH_4

29. Basic principles of embryonic development were pronounced by: *(1990)*
    a. Von Baer b. Weismann
    c. Haeckel d. Morgan

30. Evolution is: *(1989)*
    a. Progressive development of a race
    b. History and development of race alongwith variations
    c. History of race
    d. Development of race

31. "Continuity of germplasm" theory was given by: *(1989)*
    a. de Vries b. Weismann
    c. Darwin d. Lamarck

32. Theory of inheritance of acquired characters was given by: *(1989)*
    a. Wallace b. Lamarck
    c. Darwin d. De Vries

33. 'Origin of Species' was written by: *(1989)*
    a. Oparin b. Weismann
    c. Lamarck d. Darwin

Evidences of Evolution

34. Which of the following statements is not true? [MR*] *(2022)*
a. Flippers of penguins and dolphins are a pair of homologous organs
b. Analogous structures are a result of convergent evolution
c. Sweet potato and potato is an example of analogy
d. Homology indicates common ancestry

35. Flippers of Penguins and Dolphins are examples of: *(2020)*
a. Convergent evolution b. Industrial melanism
c. Natural selection d. Adaptive radiation

36. Which of the following refer to correct example(s) of organisms which have evolved due to changes in environment brought about by anthropogenic action? *(2020)*
1. Darwin's Finches of Galapagos islands.
2. Herbicide resistant weeds.
3. Drug resistant eukaryotes.
4. Man-created breeds of domesticated animals like dogs.
a. (1) and (3) b. (2), (3) and (4)
c. Only (4) d. Only (2)

37. Embryological support for evolution was disapproved by: [MR] *(2020)*
a. Alfred Wallance
b. Charles Darwin
c. Oparin
d. Karl Ernst von Baer

38. Embryological support for evolution was proposed by: *(2020-Covid)*
a. Karl Ernst von Baer b. Charles Darwin
c. Alfred Wallace d. Ernst Heckel

39. The similarity of bone structure in the forelimbs of many vertebrates is an example of: *(2018)*
a. Homology b. Analogy
c. Convergent evolution d. Adaptive radiation

40. Among the following sets of examples for divergent evolution, select the incorrect option: *(2018)*
a. Forelimbs of man, bat and cheetah
b. Heart of bat, man and cheetah
c. Brain of bat, man and cheetah
d. Eye of octopus, bat and man

41. Analogous structures are a result of: *(2016 - I)*
a. Divergent evolution b. Convergent evolution
c. Shared ancestry d. Stabilising selection

42. Which of the following structures are homologues to the wing of a bird? *(2016 - I)*
a. Dorsal fin of a Shark d. Wing of a Moth
c. Hind limb of Rabbit d. Flipper of Whale

43. The wings of a bird and the wings of an insect are: *(2015 Pre)*
a. Analogous structures and represent convergent evolution
b. Phylogenetic structures and represent divergent evolution
c. Homologous structures and represent convergent evolution
d. Homologous structures and represent divergent evolution

44. Industrial melanism is an example of: *(2015 Re)*
a. Natural selection b. Mutation
c. Neo Lamarckism d. Neo Darwinism

45. Forelimbs of cat, lizard used in walking; forelimbs of whale used in swimming and forelimbs of bats used in flying are an example of: *(2014)*
a. Convergent evolution b. Analogous organs
c. Adaptive radiation d. Homologous organs

46. Which one of the following are analogous structures? *(2014)*
a. Flippers of dolphin and legs of horse
b. Wings of bat and wings of pigeon
c. Gills of prawn and lungs of man
d. Thorns of *Bougainvillea* and tendrils of *Cucurbita*

47. The process by which organisms with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge, is called: *(2013)*
a. Adaptive radiation b. Natural selection
c. Convergent evolution d. Non-random evolution

48. The eye of octopus and eye of cat show different patterns of structure, yet they perform similar function. This is an example of: *(2013)*
a. Analogous organs that have evolved due to divergent evolution
b. Homologous organs that have evolved due to convergent evolution
c. Homologous organs that have evolved due to divergent evolution
d. Analogous organs that have evolved due to convergent evolution

49. Which one of the following options gives one correct example each of convergent evolution and divergent evolution? [MR*] *(2012 Pre)*

	Convergent evolution	Divergent evolution
a.	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Eyes of Octopus and mammals
b.	Eyes of octopus and mammals	Bones of forelimbs of vertebrates
c.	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Wings of butterflies and birds
d.	Bones of forelimbs of vertebrates	Wings of butterfly and birds

50. Sweet potato is homologous to: *(2011 Mains)*
a. Ginger b. Turnip
c. Potato d. *Colocasia*

51. Dark coloured Peppered Moth is able to survive in industrial areas as compared to light coloured form because of: *(2009)*
a. High fecundity
b. Mimicry
c. Natural selection in smoky environment
d. Lethal mutation

52. Industrial melanism as found in peppered moth proves that: *(2007)*
a. Melanic form has no selective advantage in industrial area
b. Lighter form has no selective advantage in polluted industrial area and non-polluted area
c. Melanism is pollution generated feature
d. True black melanic form develops by recurring random mutation

53. Given below are four statements (A-D) with one or two blanks. Select the option which fills up the blanks in two statements. [MR*] *(2007)*
Statements:
A. Wings of butterfly and birds look alike and are the result of ... (i) ... evolution
B. Miller showed that CH_4, H_2, NH_3 and ... (i) ... when exposed to electric discharge in a flask resulted in formation of ...(ii)... evidence
C. Vermiform appendix is a ... (i) ... organ an ....(ii)..... evidence of evolution.
D. According to Darwin evolution took place due to ... (i) ... and ... (ii) ... of the fittest
a. D- (i) small variations, (ii) survival, A - (i) convergent
b. A-(i) convergent, B - (i) oxygen; (ii) nucleotides
c. B - (i) water vapors (ii) amino acids, C- (i) rudimentary (ii) anatomical
d. C - (i) vestigial (ii) anatomical, D - (i) mutations (ii) multiplication

54. Two species of different genealogy shows resemblance due to similar adaptation. The phenomenon is: *(2007)*
a. Convergent evolution b. Divergent evolution
c. Micro-evolution d. Co-evolution

55. Tendrils of *Cucurbita* and thorns of *Bougainvillea* are: *(2007)*
a. Homologous organs b. Analogous organs
c. Vestigial organs d. Atavistic divergence

56. Important evidence in favour of organic evolution is the occurrence of: *(2006)*
a. Homologous and analogous organs
b. Homologous and vestigial organs
c. Analogous and vestigial organs
d. Homologous organs only

57. Which is relatively most accurate method of dating of fossils? *(2005)*
a. Radiocarbon method
b. Potassium - Argon method
c. Electron spin - Resonance method
d. Uranium - Lead method

58. Age of fossils in the past was generally determined by radio-carbon method and other methods involving radioactive elements found in the rocks. More precise methods, which were used recently and led to the revision of the evolutionary periods for differents groups of organisms includes: *(2004)*
a. Study of the conditions of fossilisation
b. Electron spin resonance (ESR) & fossil DNA
c. Study of carbohydrates/proteins in rocks
d. Study of carbohydrates/proteins in fossils

59. Convergent evolution is illustrated by: *(2003)*
a. Rat and dog b. Bacterium and protozoan
c. Starfish and cuttle fish d. Dogfish and whale

60. Industrial melanism is an example of: *(2003)*
a. Drug resistance
b. Darkening of skin due to smoke from industries
c. Protective resemblance with the surroundings
d. Defensive adaptation of skin against ultraviolet radiations

61. Which one of the following describes correctly the homologous structures? *(2003)*
a. Organs with anatomical similarities, but performing different functions
b. Organs with anatomical dissimilarities, but performing same function
c. Organs that have no function now, but had an important function in ancestors
d. Organs appearing only in embryonic stage and disappearing later in the adult

62. Sequence of which of the following is used to know the phylogeny? *(2002)*
a. mRNA b. rRNA
c. tRNA d. DNA

63. Which of the following are homologous organs? *(2002)*
a. Wings of birds & Locust
b. Wings of birds (Sparrow) & Pectoral fins of fish
c. Wings of bat & Butterfly
d. Legs of frog & Cockroach

64. Similarities in organism with different genotype indicates: *(2001)*
a. Microevolution b. Macroevolution
c. Convergent evolution d. Divergent evolution

65. Which is not a vestigial organ in man? *(2000)*
a. Third molar
b. Nails
c. Segmental muscles of abdomen
d. Coccyx

66. Homologous organs are: *(1999)*
a. Wings of cockroach and wings of bats
b. Wings of Insects and wings of birds.
c. Air bladder of fishes and lungs of frog
d. Pectoral fins of fishes and forelimbs of horse

67. Industrial melanism is example of: *(1999)*
a. Natural selection b. Mutation
c. Racial difference d. Predation

68. Evolutionary convergence is characterised by: *(1997)*
a. Development of dissimilar characteristics in closely related groups
b. Development of a common set of characteristics in groups of different ancestry
c. Development of characteristics by random mating
d. Replacement of common characteristics by random different groups

69. Which of the following is the correct group of vestigial organs in man? *(1996)*
a. Nictitating membrane, ear muscles, eyelids and coccyx
b. Appendix, coccyx, ear muscles and elbow joint
c. Wisdom tooth, coccyx, body hairs and ear muscles
d. Wisdom tooth, body hairs, nictitating membrane and vermiform appendix

70. The change of the lighter-coloured variety of peppered moth (*Biston betularia*) to its darker variety (*Biston carbonaria*) is due to: *(1995)*
a. Mutation b. Regeneration
c. Genetic isolation d. Temporal isolation

71. The homologous organs are those that show similarity in: *(1995)*
a. Appearance b. Function
c. Origin d. Size

72. The earliest fossil form, in the phylogeny of horse, is *(1994)*
a. *Equus* b. *Mesohippus*
c. *Eohippus* d. *Merychippus*

73. Which of the following is a pair of homologous organs? *(1994)*
a. Pectoral fin of rohu and fore-limb of horse
b. Wings of grasshopper and wings of crow
c. Lungs of rabbit and gills of rohu
d. Wings of bat and wings of butterfly

74. Evolutionary convergence is development of: *(1993)*
a. Common set of characters in group of different ancestry
b. Dissimilar characters in closely related groups
c. Common set of characters in closely related groups
d. Random mating

75. Study of fossils is: *(1991)*
a. Palaeontology b. Herpetology
c. Saurology d. Organic evolution

76. Parallelism is: *(1990)*
a. Adaptive divergence
b. Adaptive divergence of widely separated species
c. Adaptive convergence of widely different species
d. Adaptive convergence of closely related groups

77. Humming birds and Hawk illustrate: *(1988)*
a. Convergent evolution b. Homology
c. Adaptive radiation d. Parallel evolution

Adaptive Radiation

78. Select the correct group/set of Australian Marsupials exhibiting adaptive radiation. *(2023)*
a. Lemur, Anteater, Wolf
b. Tasmanian wolf, Bobcat, Marsupial mole
c. Numbat, Spotted cuscus, Flying phalanger
d. Mole, Flying squirrel, Tasmanian tiger cat

79. Match the following: [MR*] *(2021)*

List-I		List-II	
(A)	Adaptive radiation	(i)	Selection of resistant varieties due to excessive use of herbicides and pesticides
(B)	Convergent evolution	(ii)	Bones of forelimbs in Man and Whale
(C)	Divergent evolution	(iii)	Wings of Butterfly and Bird
(D)	Evolution by anthropogenic action	(iv)	Darwin Finches

Choose the correct answer from the options given below.
a. A-iii B-ii C-i D-iv
b. A-ii B-i C-iv D-iii
c. A-i B-iv C-iii D-ii
d. A-iv B-iii C-ii D-i

80. The phenomenon of evolution of different species in a given geographical area starting from a point and spreading to other habitats is called- *(2020-Covid)*
a. Co-evolution b. Natural selection
c. Adaptive radiation d. Saltation

81. Evolution of different species in a given area starting from a point and spreading to other geographical areas is known as: *(2012 Pre)*
a. Divergent evolution b. Adaptive radiation
c. Natural selection d. Migration

82. Adaptive radiation is: *(2007)*
a. Evolution of different species from a common ancestor
b. Adaptation due to geographical isolation
c. Migration of members of a species to different geographical areas
d. Power of adaptation of an individual to a variety of environments

83. Finches of Galapagos provide evidence for: *(2007)*
a. Retrogressive evolution
b. Special creation
c. Biogeographically evolution
d. Evolution due to mutation

84. Which evidence of evolution related to Darwin's finches? *(2000)*
a. Evidences from biogeographical distribution
b. Evidences from comparative anatomy
c. Evidences from embryology
d. Evidences from palaeotological

Biological Evolution And Mechanism of Evolution

85. Select the correct statement regarding mutation theory of evolution. *(2022 Re)*
a. Large differences due to mutations arise gradually in a population
b. This theory was proposed by Alfred Wallace
c. Variations are small directional changes
d. Single step large mutation is a cause of speciation

86. Natural selection where more individuals acquired specific character value other than the mean character value, leads to: *(2022)*
a. Random change b. Stabilising change
c. Directional change d. Disruptive change

87. Variations caused by mutation, as proposed by Hugo de Vries are *(2019)*
a. Random and directional b. Random and directionless
c. Small and directional d. Small and directionless

88. In a species, the weight of newborn ranges from 2 to 5 kg. 97% of the newborn with an average weight between 3 to 3.3 kg survive whereas 99% of the infants born with weight from 2 to 2.5 kg or 4.5 to 5 kg die. Which type of selection process is taking place? [MR*] *(2019)*
a. Directional Selection b. Stabilising Selection
c. Disruptive Selection d. Cyclical Selection

89. According to Hugo de Vries, the mechanism of evolution is: *(2018)*
a. Multiple step mutations
b. Saltation
c. Phenotypic variations
d. Minor mutations

90. Artificial selection to obtain cows yielding higher milk output represents: *(2017-Delhi)*
a. Stabilising selection as it stabilises this character in the population.
b. Directional as it pushes the mean of the character in one direction.
c. Disruptive as it splits the population into two one yielding higher output and the other lower output.
d. Stabilising followed by disruptive as it stabilises the population to produce higher yielding cows.

91. According to Darwin, the organic evolution is due to: *(2013)*
a. Reduced feeding efficiency in one species due to the presence of interfering species
b. Intraspecific competition
c. Interspecific competition
d. Competition within closely related species

92. The idea of mutations was brought forth by: [MR*] *(2012 Mains)*
a. Hugo de Vries, who worked on evening primrose
b. Gregor Mendel, who worked on *Pisum sativum*
c. Hardy Weinberg, who worked on allele frequencies in a population
d. Charles Darwin, who observed a wide variety of organisms during sea voyage

93. Which one is the important consequence of geographical isolation? *(2007)*
a. Preventing speciation
b. Speciation through reproductive isolation
c. Random creation of new species
d. No change in isolated fauna

94. Select the correct statement: *(2007)*
a. Darwinian variations are small and directionless
b. Mutations are random and directionless
c. Fitness is the end result of the ability to adapt and get selected by natured
d. All mammals except whales and camels have seven cervical vertebrae

95. Which one supports Darwin's concept of natural selection? *(2005)*
a. Development of transgenic animals
b. Production of Dolly sheep by cloning
c. Prevalence of pesticide resistant insects
d. Development of organs from stem cells for organ transplantation

96. Darwin in his 'Natural Selection Theory' did not believe in any role of which one of the following in organic evolution? *(2003)*
a. Parasites and predators as natural enemies
b. Survival of the fittest
c. Struggle for existence
d. Discontinuous variations

97. Some bacteria able to grow in Streptomycin containing medium due to: *(2002)*
a. Natural selection b. Induced mutation
c. Reproductive isolation d. Genetic drift

98. Darwins theory of pangenesis shows similarity with theory of inheritance of acquired characters then what shall be correct according to it? *(2001)*
a. Useful organs become strong and developed while useless organs become extinct. These organs help in struggle for survival
b. Size of organs increase with aging
c. Development of organs is due to will power
d. There should be some physical basis of inheritance

99. Reason of diversity in living being: *(2001)*
a. Mutation
b. Long term evolutionary change
c. Gradual change
d. Short term evolutionary change

100. On Galapagos island Darwin observed variation in beaks of birds (Darwin's finches) and he concluded: *(1998)*
a. Interspecies variation
b. Intraspecies variation
c. Natural selection according to food habit
d. Inheritance of acquired characters

101. Two zoogeographical regions, separated by high mountain ranges, are: *(1995)*
a. Nearctic and Palaearctic b. Neotropical and Ethiopian
c. Oriental and Australian d. Palaearctic and Oriental

102. Weismann cut off tails of mice generation after generation but tails neither disappeared nor shortened showing that: *(1993)*
a. Darwin was correct
b. Tail is an essential organ
c. Mutation theory is wrong
d. Lamarckism was wrong in inheritance of acquired characters

103. Theory of Natural Selection dwells on: *(1993)*
a. Role of environment in evolution
b. Natural selection acting on favorable variations
c. Changes in gene complex resulting in heritable variations
d. None of the above

Hardy-Weinberg Principle

4. The factor that leads to Founder effect in a population is: *(2021)*
a. Genetic recombination b. Mutation
c. Genetic drift d. Natural selection

5. A gene locus has two alleles A and a. If the frequency of dominant allele A is 0.4, then what will be the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the population? [MR*] *(2019)*
a. 0.36(AA); 0.48(Aa); 0.16(aa)
b. 0.16(AA); 0.24(Aa); 0.36(aa)
c. 0.16(AA); 0.48(Aa); 0.36(aa)
d. 0.16(AA); 0.36(Aa); 0.48(aa)

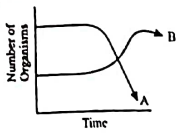
106. In Hardy-Weinberg equation, the frequency of heterozygous individual is represented by: *(2016 - II)*
a. pq b. q^2
c. p^2 d. 2pq

107. Genetic drift operates in: *(2016 - II)*
a. Non-reproductive population
b. Slow reproductive population
c. Small isolated population
d. Large isolated population

108. Which is the most common mechanism of genetic variation in the population of a sexually reproducing organism? *(2013)*
a. Genetic drift b. Recombination
c. Transduction d. Chromosomal aberrations

109. A population will not exist in Hardy-Weinberg equilibrium if: *(2013)*
a. There is no migration
b. The population is large
c. Individuals mate selectively
d. There are no mutations

110. The following graph depicts changes in two populations (A and B) of herbivores in a grassy field. A possible reason for these changes is that: *(2015)*



a. Population A produced more offspring than population B
b. Population A consumed the members of population B
c. Both plant populations in this habitat decreased
d. Population B competed more successfully for food than population A

111. In a population of 1000 individuals 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is: *(2014)*
a. 0.7 b. 0.4
c. 0.5 d. 0.6

112. Variation in gene frequencies within populations can occur by chance rather than by natural selection. This is referred to as: *(2013)*
a. Genetic load b. Genetic flow
c. Genetic drift d. Random mating

113. The tendency of population to remain in genetic equilibrium may be disturbed by: *(2013)*
a. Lack of random mating b. Random mating
c. Lack of migration d. Lack of mutations

114. In small isolated tribal population: *(2008)*
a. Wrestlers pass down the trait of strong muscles to the progeny
b. There is no change in population size due to large gene pool
c. There is decline in population as boys marry girls only of their tribe
d. Hereditary disease like colour blindness does not spread

115. Using imprints from a culture plate having bacterial colonies, you can select streptomycin resistant mutants and prove that such mutations do not originate as adaptation. The imprints need to be inoculated on: *(2007)*
a. Plates with and without streptomycin
b. Plates with minimal medium
c. Plates with streptomycin
d. Plates without streptomycin

116. Frequency of A allele is 0.6 and that of I allele is 0.4. What would be frequency of heterozygote's in random mating population? *(2005)*
a. 0.36 b. 0.16
c. 0.24 d. 0.48

117. Random genetic drift in a population probably results from: *(2003)*
a. Highly genetically variable individuals
b. Interbreeding within this population
c. Constant low mutation rate
d. Large population size

118. In a random mating population in equilibrium, which of the following brings about a change in gene frequency in a non-directional manner? *(2003)*
a. Mutations b. Random drift
c. Selection d. Migration

119. Which of the following is important for speciation? *(2002)*
a. Seasonal isolation
b. Reproductive isolation
c. Behavioural isolation
d. Tropical isolation

120. Genetic drift operates in : *(2002)*
a. Small isolated population
b. Large isolated population
c. Fast reproductive population
d. Slow reproductive population

121. In which condition, the gene ratio remains constant for any species? *(2002)*
a. Sexual selection b. Random mating
c. Mutation d. Gene flow

122. In Lederberg's replica plating experiment what shall be used to obtain streptomycin resistant strain? *(2001)*
a. Minimal medium and streptomycin
b. Complete medium and streptomycin
c. Only minimal medium
d. Only complete medium

123. For the coming generations are less adaptive than their parental generation due to: *(2001)*
a. Natural selection b. Mutation
c. Genetic drift d. Adaptation

124. Frequency of an allele in an isolated population may change due to: *(2001)*
a. Genetic drift b. Gene flow
c. Mutation d. Natural selection

125. Species separated by geographical barriers are called: [OS] *(1998)*
a. Allopatric b. Sympatric
c. Sibling d. Endemic

126. Genetic drift in Mendelian population takes place in: *(1998)*
a. Small population b. Large population
c. Oceanic population d. Never occurs

127. Genetic drift is change of: *(1993)*
a. Gene frequency in same generation
b. Appearance of recessive genes
c. Gene frequency from one generation to next
d. None of the above

Brief Account of Evolution

128. Jurassic period of Mesozoic era is characterised by: *(2006)*
a. Flowering plants and first dinosaurs appear
b. Gymnosperms are dominant plants and first birds appear
c. Radiation of reptiles and angiosperms appear
d. Dinosaurs become extinct and angiosperms appear

129. Presence of gills in the tadpole of frog indicates that: *(2004)*
a. Fishes evolved from frog like ancestors
b. Frogs will have gills in future
c. Frogs evolved from gilled ancestors
d. Fishes were amphibious in the past

130. In which era reptiles were dominated? *(2002)*
a. Coenozoic era b. Mesozoic era
c. Paleozoic era d. Archaeozoic era

131. Reptiles like mammals originated in: *(1999)*
a. Jurassic b. Triassic
c. Cretaseus d. Permian

132. Which of the following is a living fossil? *(1997)*
a. *Mirabilis jalapa* b. *Ginkgo biloba*
c. *Pinus longifolia* d. *Dalbergia sissoo*

133. Which of the following is an example of 'living fossils'? *(1996)*
a. *Pinus* b. *Riccia*
c. *Gnetum* d. *Ginkgo*

134. Which period is dubbed as the age of prokaryotic microbes? *(1995)*
a. Precambrian b. Phanerozoic
c. Archean d. Proterozoic

135. Correct order is: *(1991)*
a. Palaeozoic → Archaeozoic → Coenozoic
b. Archaeozoic → Palaeozoic → Proterozoic
c. Palaeozoic → Mesozoic → Coenozoic
d. Mesozoic → Archaeozoic → Proterozoic

Human Evolution

136. Identify the fossil of man who showed the following characteristics. [MR*] *(2023-Manipur)*

A. Brain capacity of 1400 cc
B. Used hides to protect their body
C. Buried their dead bodies

In the light of above statements, choose the **correct** answer from the options given below:

a. *Homo erectus* b. Neanderthal man
c. *Homo habilis* d. *Australopithecus*

137. A Hominid fossil discovered in Java in 1891, now extinct, having cranial capacity of about 900 cc was: *(2020-Covid)*

a. Neanderthal man b. *Homo sapiens*
c. *Australopithecus* d. *Homo erectus*

138. Match the hominids with their correct brain size :

A. *Homo habilis*	i. 900 cc
B. *Homo neanderthalensis*	ii. 1350 cc
C. *Homo erectus*	iii. 650-800 cc
D. *Homo sapiens*	iv. 1400 cc

Select the correct option. [MR*] *(2019)*

(A) (B) (C) (D)
a. (iii) (i) (iv) (ii)
b. (iii) (ii) (i) (iv)
c. (iii) (iv) (i) (ii)
d. (iv) (iii) (i) (ii)

139. The chronological order of human evolution from early to the recent is: [MR*] *(2016 - II)*

a. *Ramapithecus-Homo habilis-Australopithecus -Homo erectus*
b. *Australopithecus-Homo habilis-Ramapithecus -Homo erectus*
c. *Australopithecus-Ramapithecus-Homo habilis -Homo erectus*
d. *Ramapithecus-Australopithecus-Homo habilis -Homo erectus*

140. Which of the following had the smallest brain capacity? *(2015 Mains)*

a. *Homo neanderthalensis* b. *Homo habilis*
c. *Homo erectus* d. *Homo sapiens*

141. What was the most significant trend in the evolution of modern man (*Homo sapiens*) from his ancestors? *(2012 Pre, 2011 Pre)*

a. Upright posture b. Shortening of jaws
c. Binocular vision d. Increasing cranial capacity

142. The extinct human who lived 1,00,000 to 40,000 years ago, in Europe, Asia and parts of Africa, with short stature, heavy eye brows, retreating for heads, large jaws with heavy teeth, stocky bodies, a lumbering gait and stooped posture was: *(2012 Pre)*

a. *Ramapithecus* b. *Homo habilis*
c. Neanderthal human d. Cro-magnon humans

143. Which one of the following was the first to stand erect? *(2012 Pre)*

a. Peking Man b. *Australopithecus*
c. Java Man d. Cro-Magnon Man

144. What kind of evidence suggested that man is more closely related with chimpanzee than with other hominoid apes? *(2004)*

a. Comparison of chromosomes morphology only
b. Evidence from fossil remains and the fossil mitochondrial DNA alone
c. Evidence from DNA extracted from sex chromosomes, autosomes & mitochondria
d. Evidence from DNA from sex chromosomes only

145. According to fossils which discovered up to present time, origin and evolution of man was started from which country? *(2003)*

a. France b. Java
c. Africa d. China

146. Which of the following is closest relative of man? *(2001)*

a. Chimpanzee b. Gorilla
c. Orangutan d. Gibbon

147. Which of the following is correct order of the evolutionary history of man? *(2001)*

a. Peking man, *Homo sapiens*, Neanderthal man, Cromagnon man
b. Peking man, Neanderthal man, *Homo sapiens* Cromagnon man
c. Peking man, Heidalberg man, Neanderthal man, Cromagnon man
d. Peking man, Neanderthal man, *Homo sapiens* Heidalberg man

148. *Homo sapiens* have evolved in: *(2000)*

a. Paleocene b. Pleistocene
c. Oligocene d. Myocene

149. Character which is closely related to human evolution. *(2000)*

a. Disappearance of tail b. Reduction in size of jaws
c. Binocular vision d. Flat nails

150. Who is directly related to man? *(2000)*

a. Gorilla b. Rhesus
c. Gibbon d. Orangutan

151. Age of Dryopithecus: *(1998)*

a. 2.46 crore years b. 2.46 lakh year
c. 1 lakh year d. 1 crore year

152. Which of the following statement is true? *(1998)*

a. *Homo erectus* is direct ancestor of *Homo sapiens*
b. Neanderthal man is direct ancestor of modern man
c. *Australopithecus* is direct ancestor of modern man
d. Fossils of Cromagnon man were first found in Ethiopia.

153. Which of the following statements is correct regarding evolution of mankind? *(1997)*

a. *Home erectus* is preceded by *Homo habilis*
b. Neanderthal man and cro-magon man were living at the same time
c. *Australopithecus* was living in Australia
d. None of these

154. Common origin of man and chimpanzee is best shown by: *(1997)*

a. Binocular vision b. Chromosome number
c. Dental formula d. Cranial capacity

155. Which of the following changes for man in the course of evolution is probable useless? *(1996)*

a. Development of being erect
b. Development of cranial capacity
c. Loss of tail
d. Development of opposable thumb

156. Which of the following is the direct ancestor of *Homo sapiens*? *(1996)*

a. *Australopithecus* b. *H. sapiens neanderthals*
c. *Homoerectus* d. *Homo sapiens fossilis*

157. The first domesticated animal by primitive man was: *(1996)*

a. Cat b. Cow
c. Dog d. Horse

158. Which of the following isotopes is most dangerous to *Homo sapiens*? *(1995)*

a. Phosphorus-32 b. Strontium - 90
c. Caesium-137 d. Iodine-131

159. Which one of the following changes involved is irrelevant, in the evolution of man? *(1994)*

a. Perfection of hand for tool making
b. Change of diet from hard nuts and hard roots to soft food
c. Loss of tail
d. Increase in the ability to communicate with others and develop community behavior

Answer Key

1. (a)	2. (d)	3. (b)	4. (a)	5. (c)	6. (c)	7. (c)	8. (c)	9. (b)	10. (b)
11. (d)	12. (d)	13. (a)	14. (d)	15. (c)	16. (b)	17. (b)	18. (b)	19. (b)	20. (c)
21. (b)	22. (a)	23. (b)	24. (d)	25. (d)	26. (b)	27. (b)	28. (c)	29. (a)	30. (b)
31. (b)	32. (b)	33. (d)	34. (a)	35. (a)	36. (b)	37. (d)	38. (d)	39. (a)	40. (d)
41. (b)	42. (d)	43. (a)	44. (a)	45. (d)	46. (b,c)	47. (c)	48. (d)	49. (b)	50. (b)
51. (c)	52. (d)	53. (a)	54. (a)	55. (a)	56. (b)	57. (c)	58. (b)	59. (d)	60. (c)
61. (a)	62. (b)	63. (b)	64. (c)	65. (b)	66. (d)	67. (a)	68. (b)	69. (d)	70. (a)
71. (c)	72. (c)	73. (a)	74. (a)	75. (a)	76. (d)	77. (c)	78. (c)	79. (d)	80. (c)
81. (b)	82. (a)	83. (c)	84. (a)	85. (d)	86. (c)	87. (b)	88. (b)	89. (b)	90. (b)
91. (c)	92. (a)	93. (b)	94. (c)	95. (c)	96. (d)	97. (a)	98. (d)	99. (b)	100. (c)
101. (d)	102. (d)	103. (b)	104. (c)	105. (c)	106. (d)	107. (c)	108. (b)	109. (c)	110. (d)
111. (d)	112. (c)	113. (a)	114. (d)	115. (c)	116. (d)	117. (b)	118. (b)	119. (b)	120. (a)
121. (b)	122. (b)	123. (b)	124. (a)	125. (a)	126. (a)	127. (d)	128. (b)	129. (c)	130. (b)
131. (b)	132. (b)	133. (d)	134. (a)	135. (c)	136. (b)	137. (d)	138. (c)	139. (d)	140. (b)
141. (d)	142. (c)	143. (b)	144. (c)	145. (c)	146. (a)	147. (c)	148. (b)	149. (b)	150. (a)
151. (a)	152. (a)	153. (a)	154. (d)	155. (c)	156. (d)	157. (c)	158. (b)	159. (b)	

Explanations

1. **(a)** The Theory of Panspermia suggests the transfer of life's building blocks or even living organisms from other planets to Earth, possibly via meteorites or cosmic dust, contributing to the origin of life on our planet.
2. **(d)** In 1953, S.L. Miller, an American scientist created electric discharge in a closed flask containing CH_4, H_2, NH_3 and water vapor at 800°C.
3. **(b)** Life appeared 500 million years after the formation of earth, i.e., almost four billion years back.
4. **(a)** The correct sequence of events in the origin of life is synthesis of organic monomers → synthesis of organic polymers → formation of protobionts → formation of DNA - based genetic systems.
5. **(c)** Both statements are true.
6. **(c)** Pasteur - Germ theory of disease
   Mendel - Laws of Inheritance
   Weismann - Theory of Germplasm continuity
   deVries - Mutation
7. **(c)** Coacervates are spherical aggregates of lipid molecules making up a colloidal inclusion which are held together by hydrophobic forces. Microspheres are molecular aggregates of proteinoids, and these protobionts were not able to reproduce.
8. **(c)** The concept of chemical evolution is based on possible origin of life by combination of chemicals under suitable environmental conditions.
9. **(b)** Recapitulation theory or Biogenetic law states that ontogeny (development of individual) is recapitulation of phylogeny (larger ancestral groups of related organism).
10. **(b)** Phylogeny organism is the origin and diversification of any taxon or the evolutionary history of its origin and diversification.
11. **(d)** In Miller and Urey experiment, there are many amino acids that were synthesised abiotically. *E.g.*, glycine, aspartic acid and alanine but glutamic acid was not synthesised.
12. **(d)** Experiment performed by Pasteur in which he took sterilised yeast and sugar solution. After one month he observed that no life appeared in flask solution since curved flask neck act as filter. He later broke down the neck and found many organisms originated in solution.
13. **(a)** In primitive earth, atmosphere was reducing. Volcanic source of hydrogen is likely to have much larger when earth was tectonically young. In time, because of addition of biological source of oxygen, the input of oxygen to atmosphere rose and reduced primitive earth's atmosphere changed.
14. **(d)** Since a long time, plants are dispersed throughout the surface of earth. All kind of evolutionary changes and factors, during this long period, led to a great diversity in plant kingdom that we can see today.
15. **(c)** A population grows exponentially but due to the limited resources in an environment, population growth is restricted to a constant size. These limited resources in environment initiates the competition for survival of fittest. Variation which sustains the competition is selected by natural selection and evolve as a new population.
16. **(b)** Moon, having no magnetic field and no atmosphere, has no protection for water molecules.
17. **(b)** DNA is the most common genetic material. In an organism, DNA is replicated and multiplied, and passed on to the next generation. Thus, DNA plays an important role in transferring the genes and traits to next generation.
18. **(b)** Chemoheterotrophs obtain their energy from organic compounds. Past experiments have demonstrated that conditions present on primitive earth favoured the formation of organic compounds.
19. **(b)** Half-life of a radioactive isotope is the time it takes half of the isotope in a sample to decay. Half-life of carbon 14 is 5,730 years.
20. **(c)** RNA world is a hypothetical stage in which self - replicating RNA molecules proliferated before the evolution of DNA & proteins. According to this hypothesis, RNA stored both genetic information and catalysed the chemical reactions in primitive cells, evidenced by the discovery of ribozymes.
21. **(b)** Miller - Urey experiment was a chemical experiment that stimulated the condition of primitive earth and demonstrated the formation of amino acids in laboratory to support the theory of origin of life.
22. **(a)** Ernst Haeckel's biogenetic law (or theory of recapitulation) hypothesise that the development of the embryo of animal, from fertilisation to gestation/hatching (ontogeny), goes through state resembling to the successive states in evolution of animal's ancestors.
23. **(b)** Atmosphere found in primitive earth was reducing that supported the formation of organic compounds from inorganic but the current atmosphere has high concentration of oxygen.
24. **(d)** Inorganic elements such as nitrogen & hydrogen combined to form ammonia & related compounds. These nitrogenous compounds reacted with other biomolecules such as carbohydrates, lipids in presence of water to form amino acids, nucleic acids, etc.
    Polymerisation of amino acids resulted in formation of proteins, final product.
25. **(d)** Presence of gill slits in embryonical stages of all vertebrates supports Hackel's theory of recapitulation which states that stages of embryonical development represents the successive stage of evolution of animal's remote ancestors *E.g.*, gills to lungs development in embryo development is corresponding to gills in fishes to lungs in tetrapods.
26. **(b)** Theory of inheritance of acquired characters suggest that an organism bring out some changes to adapt in its environment and these changes are heritable. In industrial melanism, light coloured moths were mostly predated and ultimately lost; they did not acquire the dark-skin colour. Therefore, it does not favour Lamarck's concept.
27. **(b)** The first living organism were prokaryotic, like bacteria. Respiration was anaerobic since free oxygen was absent in the environment.
28. **(c)** Oxygen increased in the atmosphere after formation of O_2 producing microbes. Before that, earth had reducing atmosphere.
29. **(a)** Von Baer stated that embryos develop from a uniform and non-complex structure into an increasingly complicated & diverse organism.
30. **(b)** Evolution is the process of development of different kinds of living beings from earlier forms over successive generations.
31. **(b)** Weismann proposed a theory on the concept of germplasm, i.e., inheritance in a multicellular organism only takes place by means of germ cell or gametes.
32. **(b)** Lamarck is best known for his Theory of Inheritance of Acquired character which is also called Lamarckism.
33. **(d)** 'On the origin of Species' was a book written by Charles Darwin & published on 24 November, 1859. It was a scientific literature considered to be the foundation of evolutionary biology.
34. **(a)** Flippers of penguins and dolphins are a pair of analogous organs.
35. **(a)** Flippers of penguins and dolphins is an example of analogous organs. Analogous structures are anatomically different but perform similar functions and hence are a result of convergent evolution.
36. **(b)** Herbicide resistant weeds, drug resistant eukaryotes and man-created breeds of domesticated animals like dogs are examples of evolution brought about by anthropogenic action. Darwin's Finches of Galapagos islands is an example of adaptive radiation.
37. **(d)** Embryological support for evolution was disapproved on careful study performed by Karl Ernst von Baer. He noted that embryos never pass through the adult stages of other animals.
38. **(d)** Embryological support for evolution was proposed by Ernst Heckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult.
39. **(a)** Homologous organs are structurally similar and functionally different showing common ancestry, e.g. forelimbs of tetrapod.
40. **(d)** Although the camera eye of octopus is very similar to that of humans, phylogenetic and embryological analyses have suggested that their camera eyes have been acquired independently, i.e., convergent evolution.
41. **(b)** Analogous structures are a result of convergent evolution.
    Analogous organs are the organs having similar function but different structure and origin, hence are a result of convergent evolution.

42. **(d)** Homologous organs are the organs having fundamental similarity in structure and origin but different functions. Flipper of Whale is homologues to the wing of a bird.
43. **(a)** The basic structure of the wings of the insects is different from the wings of bird. However, their function is same. Thus, these are considered as analogous structures. Analogous structures represent convergent evolution.
44. **(a)** Industrial melanism: In this, number of the light coloured moth (*Biston betularia*) decreased gradually while that of melanic moth increases showing directional selection. It provided well defined example of directional selection from nature.
45. **(d)** Forelimbs of cat, lizard used in walking , forelimbs of whale used in swimming and forelimbs of bats have same basic structural plan but adapted to perform different function. They have become different due to the adaptations to the different habitat however, their origin is similar. Therefore, these are an example of homologous organs.
46. **(b,c)** Gills of prawn and lungs of man both are meant for gaseous exchange. The wings of bats and pigeons also have same function and they are anatomically different. Therefore, both option (b) and (c) shows analogous structures.
47. **(c)** The process by which organisms with different evolutionary histories evolve similar phenotypic adaptations in response to common environmental challenge is called convergent evolution.
48. **(d)** The eye of octopus and cats are example of analogous organs because of the different position of retina.
49. **(b)** Homologous structures are a result of divergent evolution, e.g. thorn and tendrils of Bougainvillea and Cucurbita while analogous structures are a result of convergent evolution, e.g., eye of the octopus and of mammals or the flippers of penguins and dolphins.
50. **(b)** Homologous organs are the organs having fundamental similarity in structure and origin but different functions, hence both turnip and sunset potato can be said that they are homologous to one another.
51. **(c)** In post industrialisation, due to air pollution, black moth was flourished well since they were able to detect predator. Hence nature select them since they were adapted to smoky environment.
52. **(d)** After industrialisation, black melanic form arose by a recurring random mutation, but its phenotype had a strong selective advantage over white form.
53. **(a)** Because of convergent evolution wing of butterfly and bird perform same function of flying. Raw material used by miller, CH_4, H_2, NH_3 and water vapour. Vermiform appendix is a vestigial organ. Evolution took place due to small variations and survival of fittest.
54. **(a)** In convergent evolution, lineages show similar morphology under the influence of similar environmental factors.
55. **(a)** Tendrils of Cucurbitae and thorns of Bougainvillea are modifications of stem. Hence they have common origin but tendrils meant for climbing and thorns for reducing transpirational loss so they are homologous.

56. (b) Homologous organs suggest common ancestry which implies that organism originated from common lineage. Analogous organs suggest convergence of organisms belongs to different taxa in terms of functions.

Vestigial organs are those which have no function now but were functional in ancestors.

57. (c) Electron spin resonance method is the most accurate method for dating of fossils.

58. (b) Electron spin resonance dating technique is used to date materials which radiocarbon dating cannot. ESR is based on natural radioactivity and measures the building up of electrons trapped inside crystals after they were formed.

59. (d) Convergent evolution is the repeated evolution of similar traits in multiple lineages. In this, unrelated organisms (dogfish & whale) often develop analogous structures (fins) by adapting to similar (aquatic) environments.

60. (c) Due to industrialisation, bark of the trees become smoky and dark - coloured. White moths were easily distinguishable on this contrasting dark background and were eaten by predators more rapidly than dark - coloured moth. Due to resemblance with the surrounding, dark - coloured moth were camouflaged and protected from predators.

61. (a) Homologous structures are those structures which are structurally similar showing common ancestry, but perform different functions, e.g., forelimbs of tetrapods.

62. (b) Phylogeny is concerned with the origin & evolution of plants. 16SrRNA is component of 30S small subunit of prokaryotic ribosome. Genes coding for 16SrRNA are used in reconstructing phylogenies due to the slow rates of evolution of this region.

63. (b) Anatomical structures of pectoral fin of fish and wings of birds are similar showing their common ancestry. Thus, these are homologous organs.

64. (c) In convergent evolution, organisms having different anatomical structures and are evolved from different ancestors, adapt to similar environment & results in functionally similar features. *E.g.*, wings of bats & butterflies.

65. (b) A nail is a claw-like keratinized plate found at the top of fingers and toes and is responsible for protecting these tips, therefore nail is not considered as vestigial organ.

66. (d) Anatomical structure of pectoral fin of fishes & forelimbs of horse are similar, i.e., pentadactyl. Therefore, these organs are called homologous.

67. (a) Industrial melanism in the peppered moth was an early test of Charles Darwin's natural selection in action and is a classic example in teaching of evolution.

68. (b) In convergent evolution, organisms not closely related in their ancestry, independently evolve traits with similar functions as a result adapt to similar environments & niches.

69. (d) Vestigial organs are organs which were functional in our ancestors. They include - appendix, sinuses, coccyx (tail bone), tonsils, wisdom teeth, some ear muscles (functional in monkeys), nictitating membrane (Plica semilunaris) and body hairs.

70. (a) Mutation is the factor that resulted in splitting of one population into two different types of skin-coloured population. But through the natural selection, dark -coloured moth was chosen over light-coloured moths.

71. (c) Homologous organs show anatomical similarity and common ancestry. They are the result of divergent evolution that has a common origin.

72. (c) The first fossil of the horse was found in north America. It was named *Eohippus*.

73. (a) Pectoral fin of Rohu has similar bone structure with the fore - limb of horse, which shows their common origin.

74. (a) Convergent evolution is independent evolution that creates analogous structures having similar functions due to adaptation with environment but were absent in last common ancestors.

75. (a) Palaeontolgy is a branch of science that deals with the study of fossils of plants & animals and structure of rocks.

76. (d) Parallelism evolution is development of similar trait in distinct species descending from same ancestor and different clades. In this, a population splits into two, yet they continue to evolve similarly. Therefore, those two distinct species are actually closely related to each other.

77. (c) Adaptive radiation is evolutionary diversification of a species into various forms and each are adaptively specialized to specific environmental niche. Humming birds & Hawk are examples of this.

78. (c) The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. Australian marsupials exhibit this phenomenon and gave varieties of marsupials, e.g., Numbat, Spotted cuscus, Flying phalanger, etc.

79. (d) The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. Darwin finches is an example of adaptive radiation.

Analogous structures are anatomically different structures though they perform similar functions and these are a result of convergent evolution. Example: wings of butterfly and bird.

Homologous organs are anatomically similar structures but perform different functions according to their needs and these are a result of divergent evolution. Example: bones of forelimbs in man and whale.

Anthropogenic evolution refers to the evolution that is caused by human beings. Example: selection of resistant varieties due to excessive use of herbicides and pesticides.

80. (c) The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. Darwin's finches represent one of the best examples of this phenomenon.

81. (b) The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. Darwin's finches represent one of the best examples of this phenomenon.

82. (a) Development of different functional structures from common ancestral form.

83. (c) Darwin's finches of Galapagos Island had common ancestors but their food habits make them to have different types of beak. It is evidence of geographical distribution.

84. (a) Darwin's finches comprise a group of 15 species endemic to the Galapagos island. Variation in species is a result of biogeographical distribution of these finches on the island.

85. (d) Hugo de Vries proposed the mutation theory, suggesting that large differences arise suddenly in populations due to mutations, which are random and lack direction.

86. (c) Directional selection occurs when individuals with traits on one side of the mean in their population survive better or reproduce more than those on the other. In other words, more individuals acquire specific character value other than the mean character value.

Stabilizing selection occurs when individuals with average phenotypes survive whereas the extreme individuals from both the ends are eliminated.

In disruptive selection, the organisms of both the extreme phenotypes are selected whereas individuals with average phenotype are eliminated.

87. (b) According to Hugo de Vries, mutations are random and directionless. de Vries believed mutation caused speciation and hence called it saltation (single step large mutation).

88. (b) The given data shows stabilising selection as most of the newborn having average weight between 3 to 3.3 kg survive and babies with less and more weight have low survival rate.

89. (b) Saltation is a mechanism proposed by Hugo de Vries for large mutations. This concept states that the world and phenomena are essentially constant and novelty can be produced only by a major sudden saltation or mutation.

90. (b) Artificial selection to obtain cow yielding higher milk output will shift the peak to one direction, hence, will be an example of directional selection.

91. (c) According to Darwin, the organic evolution it due to interspecific competition.

92. (a) Hugo de Vries gave the concept of mutation.

93. (b) Development of new species occurs, when the flow of gene is interrupted by an isolated mechanism. This isolation can occur through geographical isolation.

94. (c) Survival of fittest is the outcome of selection and proliferation of only those organisms which were most suitably adapted to the environment and get selected by nature.

95. (c) Darwin theory explained that organisms which are provided with favorable variations would survive because they are fittest for survival. Insects which are well adapted to change environment (Insecticidal spray) would prospers while prones perish.

96. (d) Discontinuous variations are the variations in phenotypic traits in which types are grouped into discrete categories with no or few intermediate phenotypes. This was rejected by Charles Darwin in his natural selection Theory. His idea of evolution was gradual, continuous & linked.

97. (a) Bacteria grown in streptomycin medium bring out some variations in their genes called mutations. During growth on antibiotic streptomycin medium, bacteria struggles for their existence but the fittest variation survives and selected by environment as streptomycin resistant bacteria.

98. (d) Theory of pangenesis suggest that minute particles called gemmules circulate throughout the body and congregate in gonads. These gemmules (physiological units) are inherited. Acquired characters are inheritable physical units in case of theory of inheritance of acquired characters.

99. (b) Since a long time (millions of years), life on earth is under the force of evolution. Accumulation of many changes, their selection and survival led us to the great diversity that we can see today.

100. (c) He concluded that all the finch species arose from one ancestral form that had adapted to a variety of feeding conditions.

101. (d) Oriental region is tropical Asia with associated continental islands and palearctic region is Eurasia above the tropics, with northern corner of Africa. Both the regions are separated by mountains and thus possess different kinds of faunas.

102. (d) Theories of biological evolution proposed by Lamarck. It states that evolution of life forms occurred by use and disuse of organs.

103. (b) Accumulation of some genetic changes can be passed on to the variations in a population, which can be passed on to next generation. Among these variation fittest is selected by nature and dwells in entire population.

104. (c) Genetic drift is a process in which there is random change in the number of alleles. In some cases the change in the allelic frequency leads to the formation of new population which is different from the parent population. It is known as founder effect. Mutation, genetic recombination and natural selection are not related to genetic drift.

105. (c) Given that,

Frequency of dominant allele (p) = 0.4

Frequency of recessive allele (q) = 1 - 0.4 = 0.6

$\therefore$ Frequency of homozygous dominant individuals (AA)

$= p^2 = (0.4)^2 = 0.16$

Frequency of heterozygous individuals (Aa)

$= 2pq = 2(0.4)(0.6) = 0.48$

Frequency of homozygous recessive individuals (aa)

$= q^2 = (0.6)^2 = 0.36$

106. (d) Hardy - Weinberg principle can be represented as $p^2 + 2pq + q^2 = 1$. Here, p^2 represents frequency of dominant allele, q^2 represents frequency of recessive alleles and 2pq represents frequency of heterozygous individual.

107. (c) Genetic drift operates in small isolated population.

108. (b) Recombination, most common mechanism of genetic variation, involves the exchange of genetic material either between multiple chromosomes or between different regions of the same chromosome.

109. (c) No mutations is one of the criteria for the population to exist in Hardy - Weinberg equilibrium. If individuals mate selectively, there will be chances of mutation and thus shifting the Hardy - Weinberg equilibrium.

110. (d) Natural selection and inheritance of useful variation over many generation which leads to formation of new species. Thus graph shows population B competed more successfully for food than population A.

111. (d) Genotype AA (p^2) = $\frac{360}{1000}$

$p = 0.6$

112. (c) Variation in gene frequencies within population can occur by chance is called genetic drift.

113. (a) The Hardy-Weinberg equilibrium can be disturbed by a number of factors including mutations, natural selection, non-random mating, genetic drift, and gene flow (immigration, emigration, or migration).

114. (d) The population can be defined as a group or assemblage of organisms of the same species that live at a given time in a particular area. Dominant X-linked gene is necessary for the formation of colour sensitive cells. The recessive form of this gene is incapable of producing color sensitive cones and homozygous recessive female and hemizygous recessive are unable to distinguish between these two colors as isolated population do not have any hereditary diseases like color blindness.

115. (c) Plates having streptomycin allow to propagate only those bacteria which are resistant to the antibiotic.

116. (d) Frequency of allele A = 0.6

Frequency of allele B = 0.4

Frequency of heterozygote = 2 AB

$= 2 \times 0.6 \times 0.4 = 0.48$

117. (b) Interbreeding within a population leads to variations in a population. Any sudden change or death in that population causes the change in allelic frequency of that population, called genetic drift.

118. (b) Random drift or genetic drift brings out the change in allelic frequency due to random sampling of organisms. It is non - directional.

119. (b) Reproductive isolation refers to the inability of related species to mate and produce offspring. It is a collection of evolutionary mechanisms, behaviors and physiological processes critical for speciation.

120. (a) Genetic drift occurs due to random sampling in population. Smaller the population, greater will be effect of random drift.

121. (b) Random mating and inbreeding do not affect the gene frequency of a population.

122. (b) Esther & Joshua Lederberg performed an experiment to show that many mutations are random. Bacterial colonies were allow to grow in complete medium and then was stamped onto a new plate that contains the antibiotic streptomycin. Colonies survived on stamped plate carry mutation for streptomycin resistance.

123. (b) Mutation is the most important source of genetic variation. It may be harmful or beneficial for an individual. Due to harmful mutation, the forthcoming generation are less adaptive than their parental generation.

124. (a) Genetic drift is change in allelic frequency in a population due to random sampling error or by chance. Its effects are strongest in small populations.

125. (a) Allopatric speciation is the formation of species that happens when two populations of species are isolated from each other due to geographical changes, such species are called allopatric species.

126. (a) Genetic drift is change in allelic frequency of a population due to chance events. It takes place in populations of all sizes but its effects tend to be stronger in small populations.

127. (d) Genetic drift is change in allelic frequency of a population due to some chance events (such as geographical isolation).

128. (b) In second geological period of Mesozoic era, Jurassic gymnosperm were dominant, first primitive bird, first flying reptiles dominated this era.

129. (c) Presence of gills is a common feature in fishes. Larvae of many amphibians including frogs are aquatic creature and thus possess gills as a respiratory organ. These similarities between the larval stages of amphibians and organisms of pisces suggest that frogs were evolved from fish - like gilled ancestors.

130. (b) During mesozoic era, giant reptiles, dinosaurs and other monstrous beasts roamed the earth. This period (252 mya - 66 mya) also known as the age of reptiles or the age of dinosaurs.

131. (b) Triassic is the earliest period of mesozoic era which spans 250.9 mya. It was called the age of mammals, when reptiles like mammals started to originate.

132. (b) *Ginkgo biloba* is the only living species in division Ginkgophyta, rest all are extinct. It is found in fossils dating back 270 million years age.

133. (d) *Ginkgo* is only living species in its entire division. Its presence in fossils can trace them back upto 270 mya origin.

134. (a) Precambrian is earliest part of Earth's history. It starts with planet's creation & ends with emergence of complex multicellular life - forms (4.5 bya-540 mya). It was predominantly called as the age of prokaryotes.

135. (c) The correct sequence is Precambrian → Palaeozoic (era of ancient life) → Mesozoic (era of medieval life) → Coenozoic (era of modern life).

136. (b) Neanderthal man

The Neanderthal man (*Homo neanderthalensis*) is known for having a brain capacity of about 1400 cc, using hides for protection, and practicing burial of their dead.

137. (d) Fossils discovered in Java in 1891 revealed *Homo erectus* about 1.5 mya. *Homo erectus* had a large brain around 900cc. *Homo erectus* probably ate meat.

138. (c) The correct match of hominids and their brain sizes are :

Homo habilis — 650-800 cc

Homo neanderthalensis — 1400 cc

Homo erectus — 900 cc

Homo sapiens — 1350 cc

139. (d) The chronological order of human evolution from early to the recent is *Ramapithecus* (more man-like) → *Australopithecus* (hunted with stone weapons) → *Homohabilis* (first human-like being) → *Homo erectus* (fossils were discovered in 1891).

140. (b) *Homo habilis* - 650-800 cc

Homo erectus - 900 cc

Neanderthal man - 1400 cc

Homo sapiens - 1350 cc

141. (d) The most significant trend in the evolution of modern man (*Homo sapiens*) from his ancestors is increasing cranial capacity.

142. (c) The Neanderthal man with a brain size of 1450cc lived in near east and central Asia between 1,00,000-40,000 years back. They used hides to protect their body and buried their dead.

143. (b) *Australopithecus* was the first to stand erect.

144. (c) Hominidae is a family of organisms that includes humans, chimpanzees, gorillas, orangutans & their extinct ancestors. Comparison of anatomy and genetics reveals that among the living animals, in this group, humans are closely related to chimpanzees.

145. (c) According to the recent out-of Africa model of modern human hypothesis, anatomically modern humans started moving from Africa to Eurasia and replacing earlier humans.

146. (a) Based on certain comparative evidences of fossils and genes, chimpanzees are most closely related to humans than other hominid apes.

147. (c) Fossils of *Homo erectus pekinensis* dated roughly 750,000 years ago and of *Homo heidelbergensis* dated 500,000 years ago recovered in Ethiopia. Palaeontological evidences suggest that Neanderthals existed around 150,000 years ago followed by Cromagnons - like humans dated 43,000 - 45,000 years ago.

148. (b) *Homo sapiens* have evolved from the beginning of the pleistocene (2.5 mya) to present day within a single, continuous human species.

149. (b) With changing in food habits, posterior tooth & jaw size reduced during the human evolution.

150. (a) Gorilla share a more recent ancestry (than other monkeys) with humans.

151. (a) Dryopithecus is found as fossils in miocene & Pliocene deposits (23 to 2.6 mya).

152. (a) A population of *Homo erectus* remained in Africa and evolved into *Homo sapiens* and modern man has directly evolved from Cro-magnon man.

153. (a) Human evolution:

Australopithecus afarensis → *Australopithecus africanus* → *Homo habilis*

(3.9 - 2.9 mya) (3.3-2.1 mya) (2.1-1.5 mya)

→ *Homo erectus* → *Homo heidelbergensis* → *Homo neanderthalinsi*

(1.9-0.14 mya) (800-300 kya) (400-28 kya)

→ Cro-magnon → Modern man

(43-45kya) (30-kya-present)

154. (d) Cranial capacity is a major factor in studying the evolution of man. Range of variation of cranial capacity for modern *H. sapiens* is about 1000 c.c. and for chimpanzee is 320 - 480 c.c.

155. (c) Ancestors of humans (old world monkeys) had tails which helped them in their habitat & lifestyle on trees but during the evolution any organ that is not used for a long time disappears. As we started developing many good features for locomotion, balance & communication, it was never a big loss for us to lose the tail.

156. (d) *H.sapiens fossilis* (cro-magnon) were direct ancestor of modern human beings (*H.sapiens sapiens*).

157. (c) The first domesticated animal by primitive man was dog.

158. (b) The radioactive strontium - 90 can lead to various bone disorders and diseases, including bone cancer. It emits high energy beta radiations. Phosphorus - 32 also emit high energy beta radiations but they cannot penetrate human skin. Caesium - 137 (beta emitter) and iodine - 131 (b and g emitter) also pose danger to human health but not as much strontium - 90 which is a long-lived radioactive element and tends to cycle like calcium.

159. (b) Diet change is out of choice & priority, hence, it is irrelevant in terms of evolution.

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CHAPTER 7

Human Health and Diseases

Common Disease in Humans

1. Match List-I with List-II [MR*] *(2023)*

List-I		List-II	
(A)	Ringworm	(I)	*Haemophilus Influenzae*
(B)	Filariasis	(II)	*Trichophyton.*
(C)	Malaria	(III)	*Wuchereria bancrofti*
(D)	Pneumonia	(IV)	*Plasmodium vivax*

Choose the correct answer from the options given below:

a. A-III, B-II, C-IV, D-I b. A-II, B-III, C-IV, D-I
c. A-II, B-III, C-I, D-IV d. A-III, B-II, C-I, D-IV

2. Match **List-I** with **List-II**. *(2023-Manipur)*

List-I		List-II	
(A)	Typhoid	(I)	Protozoan
(B)	Elephantiasis	(II)	*Salmonella*
(C)	Ringworm	(III)	Aschelminthes
(D)	Malaria	(IV)	*Microsporum*

Choose the **correct** answer from the options given below:

a. A-I, B-IV, C-III, D-II b. A-I, B-III, C-IV, D-II
c. A-II, B-III, C-IV, D-I d. A-II, B-IV, C-III, D-I

3. Match the following: *(2021)*

List-I		List-II	
(A)	Filariasis	(i)	*Haemophilus influenzae*
(B)	Amoebiasis	(ii)	*Trichophyton*
(C)	Pneumonia	(iii)	*Wuchereria bancrofti*
(D)	Ringworm	(iv)	*Entamoeba histolytica*

Choose the correct answer from the options given below.

a. A-iii B-iv C-i D-ii
b. A-i B-ii C-iv D-iii
c. A-ii B-iii C-i D-iv
d. A-iv B-i C-iii D-ii

4. Match the following diseases with the causative organism and select the correct option. *(2020)*

	Column - I		Column - II
1.	Typhoid	(i)	*Wuchereria*
2.	Pneumonia	(ii)	*Plasmodium*
3.	Filariasis	(iii)	*Salmonella*
4.	Malaria	(iv)	*Haemophilus*

	(1)	(2)	(3)	(4)
a.	(iii)	(iv)	(i)	(ii)
b.	(ii)	(i)	(iii)	(iv)
c.	(iv)	(i)	(ii)	(iii)
d.	(i)	(iii)	(ii)	(iv)

5. The infectious stage of *Plasmodium* that enters the human body is: *(2020)*

a. Sporozoites b. Female gametocytes
c. Male gametocytes d. Trophozoites

6. Match the following columns and select the correct option: *(2020-Covid)*

	Column-I		Column-II
1.	Typhoid	(i)	*Haemophilus influenzae*
2.	Malaria	(ii)	*Wuchereria bancrofti*
3.	Pneumonia	(iii)	*Plasmodium vivax*
4.	Filariasis	(iv)	*Salmonella typhi*

	(1)	(2)	(3)	(4)
a.	(iii)	(iv)	(ii)	(i)
b.	(i)	(iii)	(ii)	(iv)
c.	(i)	(ii)	(iv)	(iii)
d.	(iv)	(iii)	(i)	(ii)

7. Identify the correct pair representing the causative agent of typhoid fever and the confirmatory test for typhoid. *(2019)*

a. *Plasmodium vivax* / UTI test
b. *Streptococcus pneumoniae* / Widal test
c. *Salmonella typhi* / Anthrone test
d. *Salmonella typhi* / Widal test

8. In which disease does mosquito transmitted pathogen cause chronic inflammation of lymphatic vessels? *(2018)*

a. Elephantiasis b. Ascariasis
c. Ringworm disease d. Amoebiasis

9. Which of the following is not an autoimmune disease? *(2018)*

a. Psoriasis b. Rheumatoid arthritis
c. Alzheimer's disease d. Vitiligo

10. Which of the following sets of diseases is caused by bacteria? *(2016 - II)*

a. Tetanus and mumps b. Herpes and influenza
c. Cholera and tetanus d. Typhoid and smallpox

11. The organisms which cause diseases in plants and animals are called: *(2016 - I)*

a. Pathogens b. Vectors
c. Insects d. Worms

12. Which of the following viruses is not transferred through semen of an infected male? *(2015)*

a. Chikungunya virus
b. Ebola virus
c. Hepatitis B virus
d. Human immunodeficiency virus

13. Match each disease with its correct type of vaccine: *(2015)*

A.	Tuberculosis	(i)	Harmless virus
B.	Whooping cough	(ii)	Inactivated toxin
C.	Diphtheria	(iii)	Killed bacteria
D.	Polio	(iv)	Harmless bacteria

a. A-iv B-iii C-ii D-i
b. A-i B-ii C-iv D-iii
c. A-ii B-i C-iii D-iv
d. A-iii B-ii C-iv D-i

14. The active form of *Entamoeba histolytica* feeds upon: *(2015)*

a. Food in intestine
b. Blood only
c. Erythrocytes; mucosa and submucosa of colon
d. Mucosa and submucosa of colon only

15. Which of the following diseases is caused by a protozoan? *(2015 Re)*

a. Influenza b. Babesiosis
c. Blastomycosis d. Syphilis

16. Infection of *Ascaris* usually occurs by: *(2013)*

a. Mosquito bite
b. Drinking water containing eggs of *Ascaris*
c. Eating imperfectly cooked port
d. Tse-tse fly

17. Which one of the following sets of items in the options a. - d. are correctly categorised with one exception in it? [MR*] *(2012 Mains)*

	Items	Category	Exception
a.	UAA, UAG, UGA	Stop codons	UAG
b.	Kangaroo, Koala, Wombat	Australian marsupials	Wombat
c.	*Plasmodium*, *Cuscuta*, *Trypanosoma*	Protozoan parasites	*Cuscuta*
d.	Typhoid, Pneumonia, Diphtheria	Bacterial diseases	Diphtheria

18. Motile zygote of *Plasmodium* occurs in: *(2012 Pre)*

a. Human liver
b. Gut of female *Anopheles*
c. Salivary glands of *Anopheles*
d. Human RBCs

19. Widal test is carried out to test: *(2012 Pre)*

a. Typhoid fever b. Malaria
c. Diabetes mellitus d. HIV/AIDS

20. Common cold differs from pneumonia in, that: [MR*] *(2012 Pre)*

a. Pneumonia pathogen infects alveoli whereas the common cold affects nose and respiratory passage but not the lungs
b. Pneumonia is a communicable disease whereas the common cold is a nutritional deficiency disease
c. Pneumonia can be prevented by a live attenuated bacterial vaccine whereas the common cold has no effective vaccine
d. Pneumonia is caused by a virus while the common cold is caused by the bacterium *Haemophilus influenzae*

21. Which one of the following options gives the correct matching of a disease with its causative organism and mode of infection? *(2011 Mains)*

	Disease	Causative Organisms	Mode of Infection
a.	Elephantiasis	*Wuchereria bancrofti*	With infected water and food
b.	Malaria	*Plasmodium vivax*	Bite of male Anopheles mosquito
c.	Typhoid	*Salmonella typhi*	With inspired air
d.	Pneumonia	*Streptococcus Pneumoniae*	Droplet infection

22. Common cold is not cured by antibiotics because it is: *(2011 Mains)*

a. Caused by a Gram-negative bacterium
b. Not an infectious disease
c. Caused by a virus
d. Caused by a Gram-positive bacterium

23. The pathogen *Microsporum* responsible for ringworm disease in humans belongs to the same Kingdom of organisms as that of: *(2011 Mains)*

a. *Rhizopus*, a mould b. *Ascaris*, a round worm
c. *Taenia*, a tapeworm d. *Wuchereria*, a filarial worm

24. Where will you look for the sporozoites of the malarial parasite? *(2011 Pre)*

a. Salivary glands of freshly molted female *Anopheles* mosquito
b. Saliva of infected female *Anopheles* mosquito
c. Red blood corpuscles of humans suffering from malaria
d. Spleen of infected humans

25. Ringworm in humans is caused by: *(2010 Pre)*

a. Fungi b. Nematodes
c. Viruses d. Bacteria

26. Widal test is used for the diagnosis of: *(2010 Pre)*
a. Typhoid b. Plague
c. Pneumonia d. Diphtheria

27. Pair of viral diseases is: *(2009)*
a. Ringworm, AIDS b. Typhoid, Tuberculosis
c. Dysentery, Common cold d. Common cold, AIDS

28. Match the columns: *(2008)*

	I		II
A.	Amoebiasis	i.	*Treponema pallidum*
B.	Diphtheria	ii.	Use only sterilied food and water
C.	Cholera	iii.	DPT vaccine
D.	Syphilis	iv.	Use oral rehydration therapy

a. A-i B-ii C-iii D-iv
b. A-ii B-iii C-iv D-i
c. A-i B-ii C-iv D-iii
d. A-ii B-iv C-i D-iii

29. Increased asthmatic attacks in certain seasons are due to: *(2007)*
a. Inhalation of seasonal pollen
b. Heat and humidity
c. Low temperature
d. Eating preserved fruits

30. Which one of the following is not correctly matched? *(2004)*
a. *Culex pipiens* - Filariasis
b. *Aedes aegypti* - Yellow fever
c. *Anopheles culicifacies* - Leishmaniasis
d. *Glossina palpalis* - Sleeping sickness

During its life-cycle, *Fasciola hepatica* (liver fluke) infects its intermediate host and primary host at the following larval stages respectively: *(2003)*
a. Redia and miracidium
b. Cercaria and redia
c. Metacercaria and cercaria
d. Miracidium and metacercaria

32. Which one of the following conditions though harmful in itself, is also a potential saviour from a mosquito borne infectious disease? *(2003)*
a. Thalassemia b. Sickle cell anaemia
c. Pernicious anaemia d. Leukemia

33. Christmas disease is another name for: *(2003)*
a. Haemophilia B b. Hepatitis B
c. Down's syndrome d. Sleeping sickness

34. Stool of a person contain whitish grey colour due to malfunction of which type of organ? *(2002)*
a. Pancreas b. Spleen
c. Kidney d. Liver

35. Which of the following is the most infectious disease: *(2001)*
a. Hepatitis-B b. AIDS
c. Cough and cold d. Malaria

36. *Salmonella* is related with: *(2001)*
a. Typhoid b. Polio
c. T.B. d. Tetanus

37. Which is showing accurate pairing? *(2000)*
a. Syphilis- *Treponema pallidum*
b. AIDS - *Bacillus conjugalis*
c. Gonorrhoea - *Leishmania denovoni*
d. Typhoid - *Mycobacterium leprae*

38. Saline solution is given to patients of cholera because: *(2000)*
a. Na^+ prevents water loss from body
b. NaCl function as regulatory material
c. NaCl produces energy
d. NaCl is antibacterial

39. Koch's postulates not applicable to: *(1999)*
a. *Mycobacterium leprae* b. Tuberculosis
c. Pneumonia d. Cholera

40. Typhoid caused by: *(1998)*
a. *Rickettsiae* b. *Chlamydia*
c. *Salmonella typhi* d. *Mycobacterium*

41. Which of the following will be curable in next two decades? *(1997)*
a. Tuberculosis b. Cancer
c. Poliomyelitis d. None of these

42. Diphtheria is caused by: *(1997)*
a. Nematodes b. Bacteria
c. Virus d. None of these

43. Which of the following diseases is now considered completely eradicated from India? *(1997)*
a. Small pox b. Poliomyelitis
c. Plague d. Kala-azar

44. Which of the following symptoms indicate red sickness? *(1997)*
a. Nausea and loss of hair
b. Ulcerated skin, nausea and loss of hair
c. Red and ulcerated skin
d. Nausea and anaemia

45. Which of the following pair of diseases is caused by virus? *(1996)*
a. Rabies, mumps b. Cholera, tuberculosis
c. Typhoid, tetanus d. AIDS, syphilis

46. Which one of the following pairs is not correctly matched? *(1995)*
a. Syphilis — *Trichuris trichiura*
b. Sleeping sickness — *Trypanosoma gambiense*
c. Dengue fever — *Arbovirus*
d. Plague — *Yersinia pestis*

47. Which one of the following diseases is due to an allergic reaction? *(1995)*
a. Enteric fever b. Skin cancer
c. Goitre d. Hay fever

48. Which of the following causes plague? *(1995)*
a. *Trichinella spiralis* b. *Salmonella typhimurium*
c. *Yersinia pestis* d. *Leishmania donovani*

49. Which one of the following does correctly match a sexually transmitted disease with its pathogen? *(1994)*
a. Syphilis - *Treponema pallidum*
b. Gonorrhoea - *Entamoeba histolytica*
c. Urethritis - *Bacillus anthracis*
d. Softsore - *Bacillus brevis*

50. Give the correct matching of causative agent/germ and disease: *(1993)*
a. *Anopheles* Malaria
b. *Leishmania* Sleeping sickness
c. *Glossina* Kala-azar
d. *Wuchereria* Filariasis

51. Schizont stage of *Plasmodium* occurs in human cells: *(1993)*
a. Erythrocytes
b. Liver cells
c. Erythrocytes and liver cells
d. Erythrocytes, liver cells and spleen cells

52. The part of life cycle of malarial parasite *Plasmodium vivax*, that is passed in female *Anopheles* is: [OS]*(1992)*
a. Sexual cycle
b. Pre-erythrocytic schizogony
c. Exoerythrocytic schizogony
d. Post-erythrocytic schizogony

53. African sleeping sickness is due to: *(1991)*
a. *Plasmodium vivax* transmitted by tsetse fly
b. *Trypanosoma lewsii* transmitted by Bed Bug
c. *Trypanosoma gambiense* transmitted by *Glossina palpalis*
d. *Entamoeba gingivalis* spread by Housefly

54. *Plasmodium*, the malarial parasite, belongs to class: *(1990)*
a. Sarcodina b. Ciliata
c. Sporozoa d. Dinophyceae

55. Amoebiasis is prevented by: *(1990)*
a. Eating balanced food b. Eating plenty of fruits
c. Drinking boiled water d. Using mosquito nets

56. Which is true about *Trypanosoma*? *(1990)*
a. Polymorphic b. Facultative parasite
c. Monogenetic d. Non-pathogenic

57. Genetic information in *Paramoecium* is contained in: *(1990)*
a. Micronucleus
b. Macronucleus
c. Both micronucleus and macronucleus
d. Mitochondria

58. The infective stage of malarial parasite, *Plasmodium* that enters human body is: *(1990)*
a. Merozoite b. Sporozoite
c. Trophozoite d. Minute form

59. Kala-azar and oriental sore are spread by: *(1990)*
a. Housefly b. Bed bug
c. Sand fly d. Fruit fly

60. A bite of Tse-tse fly may pass to humans: *(1989)*
a. *Leishmania donovani* b. *Trypanosoma gambiense*
c. *Entamoeba histolytica* d. *Plasmodium vivax*

61. Malaria fever coincides with liberation of: *(1989)*
a. Cryptomerozoties b. Metacryptomerozoites
c. Merozoites d. Trophozoites

62. The vector for sleeping sickness is: *(1989)*
a. Housefly b. Tsetse fly
c. Sandfly d. Fruit fly

63. The causal organism for African sleeping sickness is: *(1989)*
a. *T. rhodesiense* b. *Trypanosoma cruzi*
c. *T. tangela* d. *T. gambiense*

Immunity

64. Match List-I with List-II. [MR*] *(2023-Manipur)*

List-I		List-II	
(A)	Cytokine barriers	(I)	Mucus coating of respiratory tract
(B)	Cellular barriers	(II)	Interferons
(C)	Physiological barriers	(III)	Neutrophils and Macrophages
(D)	Physical barriers	(IV)	Tears and Saliva

Choose the correct answer from the options given below:
a. A-II, B-III, C-IV, D-I b. A-III, B-I, C-IV, D-II
c. A-III, B-I, C-II, D-IV d. A-II, B-III, C-I, D-IV

65. Which of the following reasons is mainly responsible for graft rejection in transplantation of organs? *(2022 Re)*
a. Cell-mediated response
b. Inability of recipient to differentiate between 'self' and 'non-self' tissues/cells
c. Humoral immune response only
d. Auto-immune response

66. Match List-I with List-II: *(2022 Re)*

List-I		List-II	
(A)	Cellular barrier	(I)	Interferons
(B)	Cytokine barrier	(II)	Mucus
(C)	Physical barrier	(III)	Neutrophils
(D)	Physiological barrier	(IV)	HCl in gastric juice

Choose the **correct answer** from the options given

a. A-III, B-I, C-II, D-IV b. A-II, B-III, C-IV, D-I
c. A-II, B-III, C-I, D-IV d. A-III, B-IV, C-II, D-I

67. Select the **incorrect** statement with respect to acquired immunity. *(2022)*

a. Acquired immunity is non-specific type of defense present at the time of birth
b. Primary response is produced when our body encounters a pathogen for the first time.
c. Anamnestic response is elicited on subsequent encounters with the same pathogen.
d. Anamnestic response is due to memory of first encounter.

68. Given below are two statements: [MR*] *(2022)*
Statement I: Autoimmune disorder is a condition where body defense mechanism recognizes its own cells as foreign bodies.
Statement II: Rheumatoid arthritis is a condition where body does not attack self cells.
In the light of the above statements, choose the most appropriate answer from the options given below.
a. Statement I is incorrect but Statement II is correct
b. Both Statement I and Statement II are correct
c. Both statement I and statement II are incorrect
d. Statement I is correct but Statement II is incorrect

69. Identify the **wrong** statement with reference to immunity. [MR*] *(2020)*
a. When ready-made antibodies are directly given, it is called "Passive immunity".
b. Active immunity is quick and gives full response.
c. Foetus receives some antibodies from mother, it is an example for passive immunity.
d. When exposed to antigen (living or dead) antibodies are produced in the host's body. It is called " Active immunity".

70. The yellowish fluid "colostrum" secreted by mammary glands of mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant. This type of immunity is called as: *(2020-Covid)*
a. Active immunity b. Acquired immunity
c. Autoimmunity d. Passive immunity

71. Colostrum, the yellowish fluid, secreted by mother during the initial days of lactation is very essential to impart immunity to the new born infants because it contains *(2019)*
a. Natural killer cells b. Monocytes
c. Macrophages d. Immunoglobulin A

72. Which of the following immune responses is responsible for rejection of kidney graft? *(2019)*
a. Auto-immune response
b. Humoral immune response
c. Inflammatory immune response
d. Cell-mediated immune response

73. MALT constitutes about _____ percent of the lymphoid tissue in human body. *(2017-Delhi)*
a. 50% b. 20%
c. 70% d. 10%

74. Transplantation of tissues/organs fails often due to non-acceptance by the patient's body. Which type of immune-response is responsible for such rejections? *(2017-Delhi)*
a. Autoimmune response
b. Cell-mediated immune response
c. Hormonal immune response
d. Physiological immune response

75. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain: *(2016 - I)*
a. Activated pathogens b. Harvested antibodies
c. Gamma globulin d. Attenuated pathogens

76. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self cells, then it leads to: *(2016 - I)*
a. Allergic response b. Graft rejection
c. Auto-immune disease d. Active immunity

77. Grafted kidney may be rejected in a patient due to: *(2015 Re)*
a. Cell-mediated immune response
b. Passive immune response
c. Innate immune response
d. Humoral immune response

78. Which of the following immunoglobulins does constitute the largest percentage in human milk? *(2015 Re)*
a. IgM b. IgA
c. IgG d. IgD

79. The cell-mediated immunity inside the human body is carried out by: *(2013)*
a. Erythrocytes b. T-lymphocytes
c. B-lymphocytes d. Thrombocytes

80. Which one of the following statements is correct with respect to immunity? [MR*] *(2012 Mains)*
a. Preformed antibodies need to be injected to treat the bite by a viper snake.
b. The antibodies against smallpox pathogen are produced by T-lymphocytes.
c. Antibodies are protein molecules, each of which has four light chains.
d. Rejection of a kidney graft is the function of B-lymphocytes.

81. Select the correct statement with respect to diseases and immunisation: *(2011 Mains)*
a. Certain protozoan's have been used to mass produce hepatitis B vaccine
b. Injection of snake antivenom against snake bite is an example of active immunization
c. If due to some reason B-and T-lymphocytes are damaged, the body will not produce antibodies against a pathogen
d. Injection of dead / inactivated pathogens causes passive immunity

82. Which one of the following acts as a physiological barrier to the entry of microorganisms in human body? *(2011 Pre)*
a. Skin b. Epithelium of urogenital tract
c. Tears d. Monocytes

83. Consider the following statements (A - D) regarding kidney transplant and select the two correct ones out of these: *(2010 Pre)*
A. Even if a kidney transplant is proper, the recipient may need to take immunosuppressant's for a long time
B. The cell mediated immune response is responsible for the graft rejection
C. B - lymphocytes are responsible for rejection of graft
D. Acceptance or rejection of a kidney transplant depends upon specific interferon's
a. C and D b. A and C
c. A and B d. B and C

84. Which one of the following cannot be used for preparation of vaccination against plague? *(2010 Mains)*
a. Heat killed suspension of virulent bacteria
b. Formalin inactivated suspension of virulent bacteria
c. A virulent live bacteria
d. Synthetic capsular polysaccharide material

85. A person likely to develop tetanus is immunised by giving: *(2009)*
a. Weakened germs b. Preformed antibodies
c. Dead germs d. Wide spectrum antibodies

86. The letter T in T-lymphocytes refers to: *(2009)*
a. Thyroid b. Thymus
c. Thalamus d. Tonsil

87. To which type of barrier under innate immunity do saliva in mouth and tears from eyes belong? *(2008)*
a. Physiological barriers b. Physical barriers
c. Cytokine barriers d. Cellular barriers

88. Cornea transplant is seldom rejected because: *(2008)*
a. It has no blood supply
b. It is composed of enucleated cells
c. It is non-living layer
d. Its cells are least penetrable by bacteria

89. Lysozyme found in saliva, perspiration and tears, destroys: *(2007)*
a. Certain fungi b. Certain types of bacteria
c. All viruses d. Most virus infected cells

90. Antibodies are complex: *(2006)*
a. Lipoproteins b. Steroids
c. Prostaglandins d. Glycoprotein's

91. Damage to thymus in a child would lead to: *(2005)*
a. Loss of cell-mediated immunity
b. Loss of antibody-mediated immunity
c. A reduction in stem cell production
d. Reduction in haemoglobin content of blood.

92. Mast cells of connective tissue contain: *(2004)*
a. Heparin and histamine b. Heparin and calcitonin
c. Serotonin and melanin d. Vasopressin and relaxin

93. Short-lived immunity acquired from mother to foetus across placenta or through mother's milk to the infant is categorised as: *(2003)*
a. Active immunity b. Passive immunity
c. Cellular immunity d. Innate non-specific immunity

94. What is true about T-lymphocytes in mammals? *(2003)*
a. There are three main types-cytotoxic T-cell, helper T-cells and suppressor T - cells
b. These originate in lymphoid tissues
c. They scavenge damaged cells and cellular debris
d. These are produced in thyroid

95. Interferons are synthesised in response to: *(2001)*
a. Mycoplasma b. Bacteria
c. Viruses d. Fungi

96. What is true for monoclonal antibodies? *(2001)*
a. These antibodies obtained from one parent and for one antigen
b. These obtained from different parents and for one antigen
c. These obtained from one parent and for many antigens
d. These obtained from many parents and for many antigen

97. During viral infection the protein formed in host cells to resist is: *(2000)*
a. Interferon b. Antitoxin
c. Antibody d. Histone

98. During injury mast cells secrete: *(1999)*
a. Histamine b. Heparin
c. Prothrombin d. Antibodies

99. What is vaccine? *(1999)*
a. Treated bacteria, virus & protein
b. Treated algae
c. Treated fungi
d. Treated plasmodium

100. Histamine secreted by: *(1998)*
a. Mast cells b. Fibroblast
c. Histiocytes d. Plasma cells

101. If a person shows production of interferons in his body, the chances are that he has got an infection of: *(1997)*
a. Tetanus b. Malaria
c. Typhoid d. Measles

102. Antibodies are produced by: *(1996)*
a. Leucocytes b. Monocytes
c. Lymphocytes d. Spleen

103. The interferons are: *(1996)*
a. Antigen proteins b. Antiviral proteins
c. Antibiotic proteins d. All of these

104. Antigens are present: *(1995)*
a. Inside the cytoplasm b. On nuclear membrane
c. Inside the nucleus d. On cell surface

105. A cell-coded protein that is formed in response to infection, with most animal viruses, is called: *(1994)*
a. Histone b. Antibody
c. Interferon d. Antigen

106. Which one engulfs pathogen rapidly? *(1989)*
a. Acidophils b. Monocytes
c. Basophils d. Neutrophils

AIDS

107. In which blood corpuscles, the HIV undergoes replication and produces progeny viruses? *(2023)*
a. Eosinophils b. T_H cells
c. B-lymphocytes d. Basophils

. Which of the following is correct regarding AIDS causative agent HIV? *(2016 - II)*
a. HIV is undeveloped retrovirus.
b. HIV does not escape but attacks the acquired immune response.
c. HIV is enveloped virus containing one molecule of single-stranded RNA and one molecule of reverse transcriptase.
d. HIV is enveloped virus that contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase.

HIV that causes AIDS, first starts destroying: *(2015)*
a. Helper T - Lymphocytes b. Thrombocytes
c. B - Lymphocytes d. Leucocytes

110. At which stage of HIV infection does one usually show symptoms of AIDS? *(2014)*
a. When the viral DNA is produced by reverse transcriptase
b. Within 15 days of sexual contact with an infected person
c. When the infected retro virus enters host cells
d. When HIV damages large number of helper T-lymphocytes

111. At which stage of HIV infection does one usually show symptoms of AIDS? *(2011 Pre)*
a. Within 15 days of sexual contact with an infected person
b. When the infected retrovirus enters host cells
c. When viral DNA is produced by reverse transcriptase
d. When HIV replicates rapidly in helper T-lymphocytes and damages large number of these

112. A certain patient is suspected to be suffering from Acquired Immuno Deficiency Syndrome. Which diagnostic technique will you recommend for its detection? *(2011 Pre)*
a. WIDAL b. ELISA
c. MRI d. Ultrasound

113. Which one of the following statements is correct with respect to AIDS? *(2010 Pre)*
a. Drug addicts are least susceptible to HIV infection.
b. AIDS patients are being fully cured cent percent with proper care and nutrition
c. The causative HIV retrovirus enters helper T-lymphocytes thus reducing their number
d. HIV can be transmitted through eating food together with an infected person

114. AIDS is caused by HIV that principally infects: *(2005)*
a. All lymphocytes b. Activator B-cells
c. Cytotoxic T-cells d. T_4 helper lymphocytes

115. HIV infects: *(1999)*
a. RBC b. T - helper cells
c. B - cells d. Basophils

116. Nucleic acid in HIV: *(1998)*
a. ss RNA b. ds RNA
c. ss DNA d. ds DNA

Cancer

117. Which of the following statements is not true for cancer cells in relation to mutations? *(2016 - I)*
a. Mutations in proto-oncogenes accelerate the cell cycle
b. Mutations destroy telomerase inhibitor
c. Mutations inactivate the cell control
d. Mutations inhibit production of telomerase

118. Which one of the following in not a property of cancerous cells whereas the remaining three are shown? *(2012 Pre)*
a. They show contact inhibition
b. They compete with normal cells for vital nutrients
c. They do not remain confined in the area of formation
d. They divide in an uncontrolled manner

119. Which of the following techniques is safest for the detection of cancer? *(2010 Mains)*
a. Magnetic resonance imaging
b. Radiography
c. Computed tomography
d. Histopathological study.

120. What is correct? [MR*] *(2009)*
a. Malignant tumors may exhibit metastasis
b. Patients who have undergone surgery are given cannabinoids to relieve pain
c. Benign tumors show metastasis
d. Heroin accelerates body functions

121. Cancer cells are more easily damaged by radiation than normal cells because they are: *(2004)*
a. Undergoing rapid division b. Different in structure
c. Non-dividing d. Starved of mutation

122. Carcinoma refers to: *(2003)*
a. Malignant tumours of the connective tissue
b. Malignant tumours of the skin or mucous membrane
c. Malignant tumours of the colon
d. Benign tumours of the connective tissue

123. Which of the following is used in the treatment of thyroid cancer? *(2002)*
a. I^{131} b. U^{238}
c. Ra^{226} d. C^{14}

124. Cancerous cells can easily be destroyed by radiations due to: *(2002)*
a. Rapid cell division b. Lack of nutrition
c. Fast mutation d. Lack of oxygen

125. The blood cancer is known as: *(1995)*
a. Haemolysis b. Haemophilia
c. Leukemia d. Thrombosis

126. A metastatic cancerous tumour is termed ' sarcoma' if the disorder is in: *(1994)*
a. Fibroblasts b. Circulatory system
c. Immune system d. Epithelial cells

127. Malignant tertian malarial parasite, belongs to class: *(1991)*
a. *Plasmodium falciparum* b. *P. vivax*
c. *P. ovale* d. *P. malariae*

Drugs & Alcohol Abuse

128. Match List-I with List-II. [MR*] *(2023)*

	List-I		List-II
(A)	Heroin	(I)	Effect on cardiovascular system
(B)	Marijuana	(II)	Slow down body function
(C)	Cocaine	(III)	Painkiller
(D)	Morphine	(IV)	Interfere with transport dopamine

Choose the correct answer from the options given below:
a. A-III, B-IV, C-I, D-II b. A-II, B-I, C-IV, D-III
c. A-I, B-II, C-III, D-IV d. A-IV, B-III, C-II, D-I

129. Diacetyl morphine is also called as: *(2023-Manipur)*
a. Amphetamine b. Barbiturate
c. Crack d. Smack

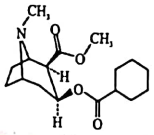
130. Drug called 'Heroin' is synthesised by *(2019)*
a. Methylation of morphine
b. Acetylation of morphine
c. Glycosylation of morphine
d. Nitration of morphine

131. Which part of poppy plant is used to obtain the drug "Smack"? *(2018)*
a. Flowers b. Latex
c. Roots d. Leaves

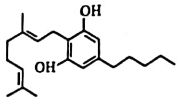
132. Which is the particular type of drug that is obtained from the plant whose one flowering branch is shown below? *(2014)*

a. Pain-killer b. Hallucinogen
c. Depressant d. Stimulant

133. Identify the molecules (A) and (B) shown below and select the right option giving their source and use: *(2012 Mains)*



(A)



(B)

	Molecule	Source	Use
a.	(A) Cocaine	*Erythraxylum coca*	Accelerates the transport of dopamine
b.	(B) Heroin	*Cannabis sativa*	Depressant and slows down body functions
c.	(B) Cannabinoids	*Atropa belladonna*	Produces hallucinations
d.	(A) Morphine	*Papaver somniferum*	Sedative and pain killer

134. Cirrhosis of liver is caused by the chronic intake of: *(2012 Pre)*
a. Cocaine b. Opium
c. Alcohol d. Tobacco (Chewing)

135. Select the correct statement from the ones given below: *(2010 Pre)*
a. Morphine is often given to a person who have undergone surgery as a pain killer
b. Chewing tobacco lowers blood pressure and heart rate
c. Cocaine is given to patients after surgery as it stimulates recovery
d. Barbiturates when given to criminals make them tell the truth

136. Use of antihistamines and steroid give a quick relief from. *(2009)*
a. Nausea b. Headache
c. Allergy d. Cough

137. What is true of the psychotropic drug? *(2008)*

a. Morphine leads to delusions and disturbed emotions

b. Barbiturates cause relaxation and temporary euphoria

c. Hashish causes after thought perceptions and hallucinations

d. Opium stimulates nervous system and causes hallucination

138. A person showing unpredictable moods, out-bursts of emotions, quarrelsome behavior and conflicts with others is suffering from: *(2006)*

a. Addictive disorders

b. Schizophrenia

c. Borderline personality disorder

d. Mood disorders

139. Drug addict shows symptoms of depressed brain activity, feeling of calmness, relaxation, drowsiness. Possibly the addiction is of: *(2005)*

a. Valium

b. Amphetamine

c. Morphine

d. Marijuana/hashish

140. Which one of the following is correct match? *(2001)*

a. Reserpine - Tranquilizer

b. Cocaine - Opiate narcotic

c. Morphine - Hallucinogenic

d. Bhang - Analgesic

141. L.S.D. is: *(2001)*

a. Hallucinogenic b. Sedative

c. Stimulant d. Tranquilizer

142. Which of the following is an opiate narcotic? *(1997)*

a. Amphetamines b. LSD

c. Barbiturates d. Morphine

143. Nicotine acts as a stimulant because it mimics the effect of: *(1995)*

a. Testosterone b. Dopamine

c. Thyroxine d. Acetylcholine

144. Opiate narcotic is: *(1993)*

a. Bhang b. Charas

c. Heroin d. Nicotine

145. Analgesic drugs: *(1990)*

a. Form tissues b. Relieve pain

c. Relieve fatigue d. Cause pain

Answer Key

1. (b)	**2.** (c)	**3.** (a)	**4.** (a)	**5.** (a)	**6.** (d)	**7.** (d)	**8.** (a)	**9.** (c)	**10.** (c)
11. (a)	**12.** (a)	**13.** (a)	**14.** (c)	**15.** (b)	**16.** (b)	**17.** (c)	**18.** (b)	**19.** (a)	**20.** (a)
21. (d)	**22.** (c)	**23.** (a)	**24.** (b)	**25.** (a)	**26.** (a)	**27.** (d)	**28.** (b)	**29.** (a)	**30.** (c)
31. (d)	**32.** (b)	**33.** (a)	**34.** (d)	**35.** (a)	**36.** (a)	**37.** (a)	**38.** (a)	**39.** (a)	**40.** (c)
41. (b)	**42.** (b)	**43.** (a)	**44.** (b)	**45.** (a)	**46.** (a)	**47.** (d)	**48.** (c)	**49.** (a)	**50.** (d)
51. (c)	**52.** (a)	**53.** (c)	**54.** (c)	**55.** (c)	**56.** (a)	**57.** (c)	**58.** (b)	**59.** (c)	**60.** (b)
61. (b)	**62.** (b)	**63.** (d)	**64.** (a)	**65.** (a)	**66.** (a)	**67.** (a)	**68.** (d)	**69.** (b)	**70.** (d)
71. (d)	**72.** (d)	**73.** (a)	**74.** (b)	**75.** (d)	**76.** (c)	**77.** (a)	**78.** (b)	**79.** (b)	**80.** (a)
81. (c)	**82.** (c)	**83.** (c)	**84.** (c)	**85.** (b)	**86.** (b)	**87.** (a)	**88.** (a)	**89.** (b)	**90.** (d)
91. (a)	**92.** (a)	**93.** (b)	**94.** (a)	**95.** (c)	**96.** (b)	**97.** (a)	**98.** (a)	**99.** (a)	**100.** (a)
101. (d)	**102.** (c)	**103.** (b)	**104.** (d)	**105.** (c)	**106.** (d)	**107.** (b)	**108.** (d)	**109.** (a)	**110.** (d)
111. (d)	**112.** (b)	**113.** (c)	**114.** (d)	**115.** (b)	**116.** (a)	**117.** (d)	**118.** (a)	**119.** (a)	**120.** (a)
121. (a)	**122.** (b)	**123.** (a)	**124.** (a)	**125.** (c)	**126.** (a)	**127.** (a)	**128.** (b)	**129.** (d)	**130.** (b)
131. (b)	**132.** (b)	**133.** (d)	**134.** (c)	**135.** (a)	**136.** (c)	**137.** (c)	**138.** (c)	**139.** (a)	**140.** (a)
141. (a)	**142.** (d)	**143.** (d)	**144.** (c)	**145.** (b)					

Explanations

1. (b) Ringworm – *Trichophyton*
Filariasis – Wuchereria bancrofti
Malaria – Plasmodium vivax
Pneumonia – Haemophilus influenzae

2. (c) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(A) Typhoid - (II) *Salmonella*
(B) Elephantiasis - (III) Aschelminthes
(C) Ringworm - (IV) *Microsporum*
(D) Malaria - (I) Protozoan

3. (a) *Wuchereria* (*W. bancrofti* and *W. malayi*), the filarial worms, cause a slowly developing chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs and the disease is called elephantiasis or filariasis.

Entamoeba histolytica is a protozoan parasite in the large intestine of human which causes amoebiasis (amoebic dysentery).

Bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia in humans which infects the alveoli (air filled sacs) of the lungs.

Many fungi belonging to the genera *Microsporum*, *Trichophyton* and *Epidermophyton* are responsible for ringworms which is one of the most common infectious diseases in man.

4. (a) Typhoid is caused by pathogenic bacterium *Salmonella typhi*. Pneumonia is caused by *Haemophilus influenzae*. Filariasis is caused by the filarial worm, *Wuchereria bancrofti* and *Wuchereria malayi*. Malaria is caused by different species of *Plasmodium*.

5. (a) *Plasmodium* enters the human body as sporozoites (Infectious stage) through the bite of Infected Female *Anopheles* mosquito.

6. (d) *Salmonella typhi* is a pathogenic bacterium which causes typhoid fever in human beings.

Plasmodium, a tiny protozoan, is responsible causing malaria.

Bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia in humans which infects the alveoli (air filled sacs) of the lungs.

Wuchereria (*W. bancrofti* and *W. malayi*), the filarial worms cause a slowly developing chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs and the disease is called elephantiasis or filariasis.

(d) *Salmonella typhi* is the causative agent. Confirmatory test is Widal test, which is based on antigen antibody reaction.

8. (a) Elephantiasis, also known as lymphatic filariasis, marked by severe swelling in limbs and genitals with inflammation of lymphatic vessels.

9. (c) Alzheimer's disease or dementia is a chronic neurodegenerative disorder.

10. (c) Cholera (*Vibrio cholera*) and tetanus (*Clostridium tetani*) is a sets of diseases which is caused by bacteria.

Dysentery, plague, diphtheria, etc., are some of the other bacterial diseases in human.

11. (a) A wide range of organisms including bacteria, viruses, fungi, protozoans, helminthes, etc., cause diseases in plants and animals. Such disease causing organisms are called pathogens. While vectors are the carriers of pathogens which may be insects or worms.

12. (a) Chikungunya is caused by the bite of *Aedes aegypti* mosquito, which requires no direct contact with body fluids like blood, semen or saline for its transmission.

13. (a) Tuberculosis - Harmless bacteria

Whooping cough - Killed bacteria

Diphtheria - Inactivated toxin

Polio - Harmless virus

14. (c) *Entamoeba histolytica* is a protozoan parasite in the large intestine of human. Symptoms of this disease include abdominal pain and cramps, stool with excess mucous and blood clots.

15. (b) Syphilis - Bacterium (*Treponema pallidum*)

Influenza - Virus (Rhinovirus)

Blastomycosis - Fungus

Babesiosis - Protozoan

16. (b) Infection occur by contaminated food and water containing eggs of *Ascaris*.

17. (c) *Plasmodium* and *Trypanosoma* are protozoan parasites while *Cuscuta* is a parasitic angiosperm. Typhoid, pneumonia and diphtheria are caused by bacteria. UAG is also a stop codon.

18. (b) When a female *Anopheles* mosquito bites an infected person, these parasites enter the mosquito's body and undergo further development. The parasites multiply within them to form sporozoites that are stored in their salivary glands.

19. (a) *Salmonella typhi* is a pathogenic bacterium which causes typhoid fever in human beings. Typhoid fever could be confirmed by Widal test.

20. (a) Bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia in humans which infects the alveoli (air filled sacs) of the lungs.

Common cold infects the nose and respiratory passage but not the lungs.

21. (d) Pneumonia, caused by bacteria S. *Pneumoniae* or *Haemophilis influenzae*, is a respiratory disease affecting lungs. This is caused by droplet effect or through simple communication with infected person.

22. (c) Common cold is caused by a virus (Rhinovirus). Any infection causing because of a virus cannot be cured using antibiotics between virus lacks cell wall & an antibiotic binds to the cell wall of the antigen to perform their function.

23. (a) The pathogen *Microsporum* responsible for ringworm disease in humans belongs to the same Kingdom of organisms as that of *Rhizopus*, a mould

24. (b) *Plasmodium* enters the human body as sporozoites (infectious form) through the bite of infected female *Anopheles* mosquito. The parasites initially multiply within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture. The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days.

25. (a) Ringworm in human is caused by fungus belonging to genera *Microsporum*, *Trichophyton* and *Epidermophyton*.

26. (a) Typhoid fever confirmed by Widal test.

27. (d) Ringworm → Fungal

Typhoid, TB → Bacteria

Virus → Common cold, AIDS

Protozoa → Dysentery

28. (b) Amoebiasis - Use sterilised food & water

Syphilis - *Treponema pallidum*

Diphtheria - DPT vaccine

Cholera - Oral Rehydration Therapy

(a) Asthma: It is common manifestation of allergy. It is characterised by the narrowing of bronchi. Pollen grains of many species of plants cause bronchial afflictions leading to chronic respiratory disorders.

(c) Leishmaniasis is caused by parasites of *Leishmania* and spread by the bite of certain sandflies.

(d) Life cycle of *F.hepatica* goes through the intermediate host and several environmental larval stages. Primary host is sheep & intermediate host is snail. In snails, miracidia develop into rediae, then to cercariae. The cercariae are released from snail to form metacercariae which is eaten by mammalian host.

32. (b) Sickle cell trait provides a survival advantage over people with normal RBCs against mosquito borne diseases such as Malaria.

33. (a) Christmas disease is a form of haemophilia caused by deficiency of the blood-clotting factor IX, also called Haemophila B. It is a rare genetic disorder that leads to prolonged bleeding.

34. (d) Pale colured stools indicates the problem of drainage of biliary system. Bile salts are released into stools by liver, giving the stools a grey colour.

35. (a) Hepatitis - B is a serious liver infection caused by Hepatitis - B virus. Transmission of virus is via blood, semen, saliva, broken skin around mouth, genitals or rectum, therefore, it is the most infectious disease.

36. (a) *Salmonella typhi* is a causative agent of typhoid.

37. (a) Bacteria *Treponema pallidum* cause the disease syphilis. AIDS is caused by the Human Immunodeficiency Virus (HIV). Gonorrhoea is bacterial infection caused by bacterium *Neisseria gonorrhoeae*. *Salmonella typhi* is a causative agent of typhoid.

38. (a) Cholera causes severe diarrhoea and dehydration, i.e., excessive loss of water from the body. The first priority in cholera treatment is to conserve water and rehydrate the body, thus, saline solution is used to prevent water loss from the body.

39. (a) Koch's postulates are criterias to establish a causative relationship between a microbe & a disease.

40. (c) *Salmonella typhi* is the causative agent of typhoid that spreads through contaminated food and water.

41. (b) By that time, cancer was incurable and lots of discoveries were going on to treat this fatal disease.

42. (b) Diphtheria is an infection of nose & throat caused by bacterium *Corynebacterium diphtheriae*.

43. (a) For around 2000 years, small pox was endemic to India. After many efforts & projects of WHO, India received "no-small pox" certificate on May 24, 1975.

44. (b) Symptoms of red sickness includes fever, runny eyes & nose, cough, rashes, nausea, headache, etc.

45. (a) Rabies & mumps are viral infections. Rabies virus is a RNA virus of Rhabdovirus family and mumps is caused by paramyxovirus of Rubulavirus family.

46. (a) Syphilis is caused by a spirochete (spiral bacterium) *Treponema pallidum*.

47. (d) Hay fever is an allergic response causing itchy, watery eyes, sneezing and other similar symptoms. It is also called as allergic rhinitis, occurs when immune system overreacts to allergens in the air.

48. (c) Plague is caused by a bacterium *Yersinia pestis*. *Y. pestis* is a facultative anaerobic organism that infect humans via oriental rat flea.

49. (a) *Treponema pallidum* is a causative agent of disease syphilis.

50. (d) Filariasis (Elephantiasis): Pathogen is Filarial worms or *Wuchereria* (*W. bancrofti* & *W. malayi*).

Mode of transmission: Bite of female *Culex* mosquito.

Symptoms: Filarial worms live in lymphatic vessels (usually of lower limbs). It causes chronic inflammation of the organs in which they live for many years. Limbs and genital organs may be deformed.

51. (c) Schizogony is the process of asexual reproduction by which *Plasmodium* undergoes asexual multiplication in liver cell and RBCs of human. These asexually multiplied stage of sporozoites of *Plasmodium* in erythrocytes (RBCs) and liver cells are called schizont stage.

52. (a) Sexual phase of life cycle of malarial parasite takes place in female *Anopheles* mosquito, whereas asexual multiplication and growth of plasmodium is a feature of life cycle in human host cells.

53. (c) African sleeping sickness is a disease caused by infection with the parasite *Trypanosoma gambiense*. This parasite is transmitted by the bite of an infected tse tse fly (belong to genus *Glossina*).

54. (c) *Plasmodium* belongs to class sporozoa. Sporozoites of *Plasmodium* is infected stage in human beings.

55. (c) *Entamoeba histolytica*, the parasite which causes amoebiasis is transmitted by contaminated water or food. Boiling of water before drinking removes any parasite contamination and thus amoebiasis can be prevented.

56. (a) *Trypanosoma* is a polymorphic parasite and show different forms of trypanosomes in a population of species.

57. (c) *Paramoecium* has one large ellipsoidal nucleus called macronucleus, which is director of cell's activities whereas the information for reproduction is contained in small nucleus, called micronucleus.

58. (b) Sporozoites present in salivary glands of female *Anopheles* mosquito is transmitted to human blood through mosquito bite.

59. (c) Kala azar (Visceral Leishmaniasis) is caused by bites from female sandflies - the vector of leishmania parasite. The sand flies feed on animals & humans for blood. Oriental sore (Cutaneous Leishmaniasis) is most common form of leishmaniasis, also caused by bite of sand fly.

60. (b) *T. gambiense* is a parasite of disease called sleeping sickness. It gets transmit through the bite of vector Tse-tse fly.

61. (b) In humans, after penetrating hepatic cells, each sporozoite multiply to produce schizont that ruptures and release thousands of cryptozoites, which penetrate healthy liver cells again to form schizonts secondary cryptozoites, which are now formed from schizonts, are called metacryptomerozoites. This cycle in liver is repeated for one week and coincide with malaria fever.

62. (b) Tsetse flies (tik-tik flies) include all the species in genus Glossina and are large biting flies. The tsetse are obligate parasites that feed on blood of vertebrates. They are biological vector of trypanosomes, which cause human sleeping sickness.

63. (d) African sleeping sickness is caused by *Trypanosoma gambiense*.

64. (a) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

(A) Cytokine barriers - (II) Interferons

(B) Cellular barriers - (III) Neutrophils and Macrophages

(C) Physiological barriers - (IV) Tears and Saliva

(D) Physical barriers - (I) Mucus coating of respiratory tract

65. (a) Graft rejection is primarily due to a cell-mediated immune response, where the recipient's immune system attacks the transplanted organ or tissue as it recognizes it as foreign.

66. (a) A-III, B-I, C-II, D-IV

Innate immunity consists of four barriers:

1. Physical barriers - Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts.

2. Physiological barrier - Acid (HCl) in stomach

3. Cellular barriers - Polymorpho-nuclear leukocytes (PMNL-Neutrophils)

4. Cytokine barrier - Interferons (secreted by virus infected cells to protect non-infected cells from further viral infection)

67. (a) Innate immunity is non-specific type of defense present at the time of birth.

68. (d) Due to genetic and other unknown reasons, the body attack self-cells. This results in damage to the body and is called auto-immune disease. Rheumatoid arthritis is an example of auto-immune disease.

69. (b) Active immunity is slow and takes time to give its full effective response.

70. (d) The yellowish fluid colostrum secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant. The foetus also receives some antibodies from their mother, through the placenta during pregnancy. These are some examples of passive immunity.

71. (d) Colostrum, the yellowish fluid, secreted by the mother during initial days of lactation is very essential to impart immunity to the new born infant because it contains antibodies (immunoglobulin A). It will provide naturally acquired passive immunity to the newborn

72. (d) The body is able to differentiate self and non-self and the cell-mediated response is responsible for graft rejection.

73. (a) MALT is Mucosa Associated Lymphoid Tissue and it constitutes about 50 percent of the lymphoid tissue in human body.

74. (b) T-lymphocytes (T-cells) mediate CMI (cell-mediated response / cell-mediated immunity). CMI causes graft rejection. The body is able to differentiate 'self' and 'non-self'. Tissue matching and blood group matching are essential before undertaking any graft/ transplant. After this, the patient has to take immune-suppressants all his life.

75. (d) Polio drops that are administered into the body contain attenuated pathogens.

76. (c) Due to genetic and other unknown reasons, the body attacks self-cells. This results in damage to the body and is called auto-immune disease. Rheumatoid arthritis which affects many people in our society is an auto-immune disease.

77. (a) Cell mediated immunity is mediated by cells of the T-lymphocytes series with antigen - specific receptors on their surfaces. It is responsible for graft rejection.

78. (b) The yellowish fluid, colostrum, secreted by mother during the initial days of lactation have abundant antibodies (IgA) to protect the infant.

79. (b) T-lymphocytes mainly generate cell-mediated immune response.

80. (a) Antibody is a protein molecule having two light chain and two heavy chain. T-cells cause transplant rejection.

81. (c) The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies. The T-cells (Thymus cells) themselves do not secrete antibodies but help B cells to produce them.

The hepatitis B vaccine contains one of the viral envelope proteins, hepatitis B surface antigen (HBsAg) which is produced by yeast cells. Injection of snake antivenom against snake bite is an example of artificially acquired passive immunity. Injection of dead / inactivated pathogens causes active immunity.

So Statement (c) is correct

82. **(c)** Acid in the stomach, saliva in the mouth, tears from eyes– all prevent microbial growth these all act as physiological barriers.

83. **(c)** Cell - mediated immunity mediated by T-lymphocytes is responsible for graft rejection. Immunosuppressant suppresses the immune response towards alien graft.

84. **(c)** A virulent live bacteria cannot be used in vaccine preparation.

85. **(b)** It required a dose of preformed antibodies because it requires quick immune response.

86. **(b)** The letter 'T' in T-lymphocytes refers to thymus. These are produced in the bone marrow but matures in thymus.

87. **(a)** Saliva found in mouth and tears are physiological barriers, prevents microbial growth.

88. **(a)** Cornea is avascular. It does not have any issue of rejection, since there is no chance of antibody - antigen interaction.

89. **(b)** Lysozyme found in saliva and tears are physiological barriers prevents microbial growth.

90. **(d)** Antibodies are glycoproteins which meant to provide immunity to body against antigen.

91. **(a)** Thymus glands secrete thymosin. Thymosin plays an important role in the differentiation of T - lymphocytes which provide cell mediated immunity.

92. **(a)** Mast cell, a granulocyte, is a part of immune system and contains many granules rich in histamine and heparin, powerful biologically active mediators.

93. **(b)** Passive immunity is short-term immunity that is the result of introduction of antibodies from outside to the body. It occurs naturally when maternal antibodies are transferred to the foetus through the placenta.

94. **(a)** T-lymphocytes play a central role in cell-mediated immunity. They are categorised in 3 main types- Cytotoxic T Lymphocyte (CTL) also called killer cells, Helper T-cells (activate B cells & macrophages) and suppressor T-Lymphocytes (play a role in immune tolerance). Other types of T cell include memory cells, natural killer cells, etc.

95. **(c)** Interferons (IFNs) are signaling molecules produced by host cells in response to the presence of pathogens such as viruses.

96. **(b)** Monoclonal antibodies are made by identical immune cells that are clones of a unique parent cell. Hence, though they are produced by different cells, they specifically recognise a single type of antigen.

97. **(a)** Interferons are signalling proteins formed by host cells during the infection of viruses of bio-synthetic secretory pathway in endoplasmic reticulum & Golgi apparatus.

98. **(a)** Most cells are abundantly found at the sites of potential injury. Histamine is released from these cells in response to antibody IgE.

99. **(a)** Vaccine is suspension of weakened, killed or fragments of microbes or toxins that is administered primarily to prevent disease.

100. **(a)** Mast cells secrete the powerful chemical mediator histamine in granules at the site of injury.

101. **(d)** Measles is a viral infection caused by Rubeola virus. Interferons are secreted by virus - infecting cells to protect the neighboring cell from infection of Rubeola.

102. **(c)** Antibodies are produced by B-lymphocytes.

103. **(b)** Interferons are signaling proteins produced by virus-infecting host cells to prevent the infection of cells from virus.

104. **(d)** An antigen is any foreign substance like protein or polysaccharide present on the external coating of pathogen, feather, constituent of vegetable, fruit, meat, drug, chemical, tissue or organ transplant which induced the immune system to produce antibodies.

105. **(c)** Interferons are signaling molecules produced by host cells in response to viral infection.

106. **(d)** Neutrophils help to fight from infections by ingesting micro-organisms & releasing the enzymes that kill those micro-organisms. It is a granulocyte.

107. **(b)** HIV enters into helper T-lymphocytes (T_H), replicates and produce progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes

108. **(d)** HIV (human immuno deficiency virus) is the causative agent of AIDS, which have an envelope enclosing the RNA genome. It contains two identical molecules of ssRNA and two molecules of reverse transcriptase.

109. **(a)** During subsequent attack on macrophage, HIV enters into helper T cells, replicates and produces progeny viruses. The progeny virus released in the blood, attack the other helper T cell.

110. **(d)** When HIV damages large number of T-lymphocytes, this distorted immune -system. In such condition, person may acquire infection even from toxoplasma.

111. **(d)** Symptoms of AIDS appear when HIV replicates rapidly in helper T-lymphocytes and damages large number of T- cells (Thymus cells).

112. **(b)** Diagnostic test for AIDS is ELISA.

ELISA is based on the principle of antigen-antibody interaction. Infection by pathogen can be detected by the presence of antigens (proteins, glycoprotein's, etc.) or by detecting the antibodies synthesised against the pathogen.

113. **(c)** Drug addicts are most susceptible to HIV. AIDS has no cure. It spreads through contact with body fluids.

114. **(d)** HIV during infection enters into the helper T-Lymphocytes (T_H), replicates and produce progeny virus. This progeny virus destroys other helper T-Lymphocytes.

115. **(b)** HIV infects vital cells in the human immune system such as helper T-lymphocytes, macrophages and dendritic cells.

116. **(a)** Human immuno deficiency virus is a retrovirus. Nucleic acid found in HIV is ss RNA (single stranded RNA).

117. **(d)** Mutations doesn't inhibit production of telomerase.

118. **(a)** Normal cells show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appear to have lost this property.

119. **(a)** MRI used strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.

120. **(a)** Metastasis exhibited by the malignant tumors. Patients undergo surgery can be given morphine (opioids). Heroin act as depressant. Benign tumors do not show metastasis.

121. **(a)** Radiation therapy is used to damage cancer cells as it affects cancer cells more than normal cells. Cancer cells divide and grow very rapidly, and are less organised than healthy cells which makes it harder for them to repair the damage done by radiation.

122. **(b)** Carcinoma is a type of malignant tumor that develops from epithelial cells. It begins in a tissue that lines the inner or outer surfaces of the body.

123. **(a)** I^{131} is radioactive iodine. Radioiodine therapy is used in the treatment of papillary and follicular thyroid cancer. I^{131} becomes toxic to cells of thyroid gland that accumulate iodine from bloodstream and in turn kills these cell.

124. **(a)** Rapidly dividing cells of cancer have very less or no time to repair the damage caused by radiations and thus radiation therapy is used to destroy cancerous cells.

125. **(c)** Leukemia is a cancer of blood-forming tissues. It is caused by an over production of damaged white blood cells (leukocytes).

126. **(a)** Sarcoma is the cancer of connective tissue. Fibroblast is a connective tissue, therefore malignancy of these cells will be termed as sarcoma.

127. **(a)** Three basic types of malaria:

1. **Benign tertian,** caused by *P. vivax & P. ovale* with a fever every 2nd day,
2. **Benign quartan,** caused by *P. malaria* with a fever every 3rd day.
3. **Malignant tertian,** caused by *P. falciparum* with more prolonged fever stage & destruction of large number of erythrocytes.

128. **(b)** Heroin is a depressant and slows down body functions. Use of marijuana causes increased heartbeat and blood pressure (cardiovascular effects). Cocaine interferes with the transport of dopamine and causes build up of dopamine in the synapses. Morphine is a very effective sedative and painkiller.

129. **(d)** Smack

Diacetyl morphine is commonly known as "smack".

130. **(b)** Heroin, commonly called smack, is chemically diacetylmorphine which is obtained by acetylation of morphine.

131. **(b)** Smack is a drug obtained from latex of plant *Papaver somniferum*.

132. **(b)** Datura has hallucinogenic properties.

133. **(d)** Molecule (A) represents structure of morphine. Morphine is the most abundant alkaloid extracted from the latex of poppy plant *Papaver somniferum*. Molecule (B) represents the structure of cannabinoid molecule. Natural cannabinoids are obtained from the inflorescences of the plant *Cannabis Sativa*.

134. **(c)** The chronic use of drugs and alcohol damages nervous system and liver (cirrhosis).

135. **(a)** Morphine acts as a sedative and has been given to a person undergone surgery.

136. **(c)** Allergy is due to release of chemicals like histamine and serotonin from mast cells.

137. **(c)** Psychotropic drugs act on the brain and alter the behavior, consciousness and power of perception. Hashish is a hallucinogen, which alters the thought of person.

138. **(c)** Borderline personality disorder: It is emotionally unstable personality disorder in which the patient suffers from unpredictable moods, outburst of emotion, uncontrolled anger and quarrelsome behavior.

139. **(a)** Valium is tranquillizers, depresses brain activity and produces feeling of calmness, relaxation and drowsiness.

140. **(a)** Reserpine is antipsychotic, antihypertensive alkaloid that has been used for controlling high blood pressure and antipsychotic symptoms (hence called tranquilizer).

141. **(a)** Lysergic acid diethylamide (LSD) is a psychedelic drug that alter the awareness of one's surroundings like other hallucinogens.

142. **(d)** Morphine is pain medication of opiate variety. It acts directly on CNS (Central Nervous System) to decrease the feeling of pain.

143. **(d)** When nicotine gets into brain, it attaches to acetylcholine receptors and mimics the action of acetylcholine (a neurotransmitter).

144. **(c)** Opiates act on opioid receptors to produce morphine - like effects such as pain - relief. Narcotics are psychoactive drug that have sleep - inducing properties. Heroin, a diamorphine, is an opioid used for its euphoric effects.

145. **(b)** Analgesic drugs are used to relieve pain (and popularly known as painkillers) without causing the loss of consciousness.

CHAPTER 8

Microbes in Human Welfare

Microbes in Household & Industrial Products

1. Identify the microorganism which is responsible for the production of an immunosuppressive molecule cyclosporin A: *(2022)*
   a. *Streptococcus cerevisiae*
   b. *Trichoderma polysporum*
   c. *Clostridium butylicum*
   d. *Aspergillus niger*

2. Match List-I with List-II. *(2021)*

List-I		List-II	
(A)	*Aspergillus niger*	(i)	Acetic Acid
(B)	*Acetobacter aceti*	(ii)	Lactic Acid
(C)	*Clostridium butylicum*	(iii)	Citric Acid
(D)	*Lactobacillus*	(iv)	Butyric acid

Choose the correct answer from the options given below.
a. A-i B-ii C-iii D-iv
b. A-ii B-iii C-i D-iv
c. A-iv B-ii C-i D-iii
d. A-iii B-i C-iv D-ii

3. Match the following columns and select the correct option. **[MR*]** *(2020)*

	Column - I		Column - II
1.	*Clostridium butylicum*	(i)	Cyclosporin-A
2.	*Trichoderma polysporum*	(ii)	Butyric acid
3.	*Monascus purpureus*	(iii)	Citric acid
4.	*Aspergillus niger*	(iv)	Blood cholesterol lowering agent

	(1)	(2)	(3)	(4)
a.	(ii)	(i)	(iv)	(iii)
b.	(i)	(ii)	(iv)	(iii)
c.	(iv)	(iii)	(ii)	(i)
d.	(iii)	(iv)	(ii)	(i)

4. For the commercial and industrial production of Citric Acid which of the following microbes is used? *(2020-Covid)*
   a. *Lactobacillus* sp
   b. *Saccharomyces cerevisiae*
   c. *Clostridium butylicum*
   d. *Aspergillus niger*

5. Cyclosporin A, used as immuno-suppression agent, is produced from: *(2020-Covid)*
   a. *Saccharomyces cerevisiae* b. *Penicillium notatum*
   c. *Trichoderma polysporum* d. *Monascus purpureus*

6. Match the following organisms with the products they produce. **[MR*]** *(2019)*

A.	*Lactobacillus*	i.	Cheese
B.	*Saccharomyces cerevisiae*	ii.	Curd
C.	*Aspergillus niger*	iii.	Citric Acid
D.	*Acetobacter aceti*	iv.	Bread
		v.	Acetic Acid

Select the correct option.

	(A)	(B)	(C)	(D)
a.	(ii)	(iv)	(v)	(iii)
b.	(ii)	(iv)	(iii)	(v)
c.	(iii)	(iv)	(v)	(i)
d.	(ii)	(i)	(iii)	(v)

7. Which of the following is a commercial blood cholesterol lowering agent? *(2019)*
   a. Cyclosporin A b. Statin
   c. Streptokinase d. Lipases

8. Conversion of milk to curd improves its nutritional value by increasing the amount of: *(2018)*
   a. Vitamin D b. Vitamin A
   c. Vitamin B_{12} d. Vitamin E

9. Which of the following is correctly matched for the product produced by them? **[MR*]** *(2017-Delhi)*
   a. *Acetobacter aceti* : Antibiotics
   b. *Methanobacterium* : Lactic acid
   c. *Penicillium notatum* : Acetic acid
   d. *Saccharomyces cerevisiae* : Ethanol

10. Match Column-I with Column-II and select the correct option using the codes given below *(2016-II)*

	Column-I		Column-II
A.	Citric acid	i.	*Trichoderma*
B.	Cyclosporin A	ii.	*Clostridium*
C.	Statins	iii.	*Aspergillus*
D.	Butyric acid	iv.	*Monascus*

Codes:
a. A-i B-iv C-ii D-iii
b. A-iii B-iv C-i D-ii
c. A-iii B-i C-ii D-iv
d. A-iii B-i C-iv D-ii

11. Which of the following is wrongly matched in the given table? **[MR*]** *(2016-I)*

	Microbe	Product	Application
a.	*Trichoderma*	Cyclosporin A	Immunosuppressive drug
b.	*Monascus*	Statins	Lowering of blood cholesterol
c.	*Streptococcus*	Streptokinase	Removal of clot from blood vessel
d.	*Clostridium butylicum*	Lipase	Removal of oil stains

12. Match the following list of microbes and their importance: *(2015 Re)*

A.	*Saccharomyces cerevisiae*	i.	Production of immunosuppressive agents
B.	*Monascus purpureus*	ii.	Ripening of Swiss cheese
C.	*Trichoderma polysporum*	iii.	Commercial production of ethanol
D.	*Propionibacterium sharmanii*	iv.	Production of blood cholesterol lowering agents

a. A-iv B-iii C-ii D-i
b. A-iv B-ii C-i D-iii
c. A-iii B-i C-iv D-ii
d. A-iii B-iv C-i D-ii

13. A good producer of citric acid is: *(2013)*
   a. *Saccharomyces* b. *Aspergillus*
   c. *Pseudomonas* d. *Clostridium*

14. Read the following statements (A - D) **[MR*]** *(2012 Mains)*
   A. Colostrum is recommended for the new born because it is rich in antigens.
   B. Chikungunya is caused by a Gram negative bacterium.
   C. Tissue culture has proved useful in obtaining virus-free plants.
   D. Beer is manufactured by distillation of fermented grape juice.
   How many of the above statements are wrong?
   a. Two b. Three
   c. Four d. One

15. *Monascus purpureus* is a yeast used commercially in the production of: *(2012 Pre)*
   a. Blood cholesterol lowering statins
   b. Ethanol
   c. Streptokinase for removing clots from the blood vessels
   d. Citric acid

16. Yeast is used in the production of: *(2012 Pre)*
   a. Cheese and butter b. Citric acid and lactic acid
   c. Lipase and pectinases d. Bread and beer

17. A patient brought to a hospital with myocardial infarction is normally immediately given: *(2012 Pre)*
   a. Statins b. Penicillin
   c. Streptokinase d. Cyclosporin–A

18. Which one of the following is a wrong matching of a microbe and its industrial product, while the remaining three are correct? *(2011 Mains)*
   a. *Clostridium butylicum* - Lactic acid
   b. *Aspergillus niger* - Citric acid
   c. Yeast - Statins
   d. *Acetobacter aceti* - Acetic acid

19. Read the following statement having two blanks (A and B) "A drug used for (A) patients is obtained from a species of the organism (B)."
   The one correct option for the two blanks is: *(2011 Mains)*

	Blank-A	Blank-B
a.	Swine flu	*Monascus*
b.	AIDS	*Pseudomonas*
c.	Heart	*Penicillium*
d.	Organ-transplant	*Trichoderma*

20. Which one is wrongly matched? *(2009)*
   a. Detergents - Lipase b. Alcohol - Nitrogenase
   c. Textile - Amylase d. Fruit juice - Pectinases

21. Modern detergents contain enzyme preparations of: *(2008)*
   a. Thermoacidophiles b. Thermophiles
   c. Acidophiles d. Alkaliphiles

22. Which one is wrongly matched? *(2007)*
   a. Yeast - Ethanol
   b. *Streptomyces* - Antibiotics
   c. Coliforms - Vinegar
   d. Methanogens - Gobar gas

23. Probiotics are: **[OS]** *(2007)*
   a. Live microbial food supplement
   b. Cancer inducing microbes
   c. New kind of food allergens
   d. Safe antibiotics

24. An enzyme that stimulates germination of Barley seeds is: **[OS]** *(2006)*
   a. Invertase b. α-amylase
   c. Lipase d. Protease

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25. For retting of Jute, the fermenting microbe is: [OS] *(2005)*
a. Methanophilic bacteria b. Butyric acid bacteria
c. *Hellcobacter pylori* d. *Streptococcus lactis*

26. The term "antibiotic" was coined by: *(2003)*
a. Edward Jenner b. Louis Pasteur
c. Selman Waksman d. Alexander Fleming

27. Which of the following secretes toxins during storage conditions of crop plants? [OS]*(2002)*
a. *Aspergillus* b. *Penicillium*
c. *Fusarium* d. *Colletotrichum*

28. During the formation of bread it becomes porous due to release of CO_2 by the action of: *(2002)*
a. Yeast b. Bacteria
c. Virus d. Protozoans

29. Which of the following is used to manufacture ethanol from starch? [OS]*(2000)*
a. *Penicillin* b. *Saccharomyces*
c. *Azotobacter* d. *Lactobacillus*

30. Which of the following yields citric acid? *(1998)*
a. *Penicillium citricum* b. *Aspergillus niger*
c. *Saccharomyces* d. *Azospirillum*

31. *Saccharomyces cerevisiae* is used in the formation of: *(1998)*
a. Ethanol b. Methanol
c. Acetic acid d. Antibiotics

32. Which of the following is the false statement about "antibiotics"? *(1996)*
a. Some persons have allergy from antibiotics
b. Antibiotics are capable of curing any disease
c. This term was given by Waksman in 1942
d. Antibiotics is produced by micro-organisms

33. The citric acid is produced by: *(1995)*
a. *Candida utilis* b. *Azotobacter subaxydans*
c. *Aspergillus niger* d. *Streptococcus lactis*

34. The organism, used for alcohol fermentation, is: *(1995)*
a. *Aspergillus* b. *Saccharomyces*
c. *Pseudomonas* d. *Penicillium*

35. In cheese manufacture, the microorganisms are important for: [OS]*(1994)*
a. The ripening only
b. The souring of milk only
c. The development of resistance to spoilage only
d. Both the souring and the ripening processes

36. The main reason why antibodies could not solve all the problems of bacteria mediated disease is: *(1994)*
a. Decreased efficiency of the immune system
b. Insensitivity of the individual following prolonged exposure to antibiotics
c. Development of mutant strains resistant to antibodies
d. Inactivation of antibiotics by bacterial enzymes

Microbes in Sewage Treatment

37. Which of the following is put into Anaerobic sludge digester for further sewage treatment? *(2020)*
a. Floating debris
b. Effluents of primary treatment
c. Activated sludge
d. Primary sludge

38. Which of the following in sewage treatment removes suspended solids? *(2017-Delhi)*
a. Tertiary treatment b. Secondary treatment
c. Primary treatment d. Sludge treatment

39. During sewage treatment, biogases are produced which include: [MR*] *(2013)*
a. Hydrogen sulphide, nitrogen, methane
b. Methane, hydrogen sulphide, carbon dioxide
c. Methane, oxygen, hydrogen sulphide
d. Hydrogen sulphide, methane, sulphur dioxide

40. Which of the followings is mainly produced by the activity of anaerobic bacteria on sewage? *(2011 Pre)*
a. Marsh gas b. Laughing gas
c. Propane d. Mustard gas

41. Sewage purification is performed by: *(1996)*
a. Microbes b. Fertilisers
c. Antibiotics d. Antiseptics

42. High BOD indicates: *(2007)*
a. Highly polluted water b. Less pollution in water
c. Less sewage d. Less microorganisms

Microbes in Production of Biogas

43. In gobar gas, the maximum amount is that of: *(2012 Mains)*
a. Butane b. Methane
c. Propane d. Carbon dioxide

44. Select the correct statement from the following: [MR*] *(2010 Pre)*
a. *Methanobacterium* is an aerobic bacterium found in rumen of cattle
b. Biogas commonly called Gobar gas is pure methane
c. Activated sludge sediment in settlement tanks of sewage treatment plant is rich source of aerobic bacteria
d. Biogas is produced by the activity of aerobic bacteria on animal waste.

45. A major component of gobar gas is: *(2004)*
a. Methane b. Ethane
c. Butane d. Ammonia

46. During anaerobic digestion of organic waste, such as in producing biogas, which one of the following is left undegraded? *(2003)*
a. Lipids b. Lignin
c. Hemi-cellulose d. Cellulose

47. Which bacteria is utilised in gobar gas plant? *(2002)*
a. Methanogens b. Nitrifying bacteria
c. Ammonifying bacteria d. Denitrifying bacteria

48. Which one produce gas by decomposing the gobar (Dung) in gobar gas? *(1999)*
a. Fungus b. Virus
c. Methanogenic bacteria d. Algae

49. Gobar gas contains mainly: *(1997)*
a. $CO_2 + H_2$ b. $CO_2 + H_2O$
c. CH_4 only d. $CH_4 + CO_2$

Microbes as Biocontrol Agents & Biofertilisers

50. Match the following columns and select the correct option: [MR*] *(2020-Covid)*

	Column-I		Column-II
1.	Dragonflies	(i)	Biocontrol agents of several plant pathogens
2.	*Bacillus thuringiensis*	(ii)	Get rid of Aphids and mosquitoes
3.	*Glomus*	(iii)	Narrow spectrum insecticidal applications
4.	Baculoviruses	(iv)	Biocontrol agents of lepidopteran plant pests
		(v)	Absorb phosphorus from soil

	(1)	(2)	(3)	(4)
a.	(ii)	(i)	(iii)	(iv)
b.	(ii)	(iii)	(iv)	(v)
c.	(ii)	(iv)	(v)	(iii)
d.	(iii)	(v)	(iv)	(i)

51. Which of the following can be used as a biocontrol agent in the treatment of plant disease? *(2019)*
a. *Trichoderma* b. *Chlorella*
c. *Anabaena* d. *Lactobacillus*

52. Select the correct group of biocontrol agents. [MR*] *(2019)*
a. *Bacillus thuringiensis*, Tobacco mosaic virus, Aphids
b. *Trichoderma*, Baculovirus, *Bacillus thuringiensis*
c. *Oscillatoria*, *Rhizobium*, *Trichoderma*
d. *Nostoc*, *Azospirillum*, *Nucleopolyhedrovirus*

53. Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition? *(2012 Pre)*
a. *Trichoderma* b. *Azotobacter*
c. *Aspergillus* d. *Glomus*

54. A nitrogen-fixing microbe associated with *Azolla* in rice fields is: *(2012 Pre)*
a. *Tolypothrix* b. *Spirulina*
c. *Anabaena* d. *Frankia*

55. Which one of the following is an example of carrying out biological control of pests/diseases using microbes? [MR*] *(2012 Pre)*
a. Lady bird beetle against aphids in mustard
b. *Trichoderma* sp. against certain plant pathogens
c. *Nucleopolyhedrovirus* against white rust in *Brassica*
d. Bt cotton to increase cotton yield

56. Consider the following statements (A-D) about organic farming: *(2011 Mains)*
A. Utilizes genetically modified crops like Bt cotton
B. Uses only naturally produced inputs like compost
C. Does not use pesticides and urea
D. Produces vegetables rich in vitamins and minerals
Which of the above statements are correct?
a. (B) and (C) only b. (A) and (B) only
c. (B), (C) and (D) d. (C) and (D) only

57. Which one of the following helps in absorption of phosphorus from soil by plants? *(2011 Pre)*
a. *Anabaena* b. *Glomus*
c. *Rhizobium* d. *Frankia*

58. Which one of the following is not a biofertiliser? *(2011 Pre)*
a. *Mycorrhiza* b. *Agrobacterium*
c. *Rhizobium* d. *Nostoc*

59. An example of endomycorrhiza is: *(2010 Mains)*
a. *Glomus* b. *Agaricus*
c. *Nostoc* d. *Rhizobium*

60. A common biocontrol agent for plant diseases is: *(2010 Pre)*
a. *Bacillus thuringiensis* b. *Glomus*
c. *Trichoderma* d. *Baculovirus*

61. Which of the following is not used in organic farming? *(2010 Pre)*
a. Earthworm b. *Oscillatoria*
c. Snail d. *Glomus*

62. The common nitrogen fixer in paddy fields is: *(2010 Pre)*
a. *Azospirillum* b. *Oscillatoria*
c. *Frankia* d. *Rhizobium*

63. Which is not used as a biopesticide? *(2009)*
a. *Xanthomonas campesteris*
b. *Bacillus thuringiensis*
c. *Trichoderma harzianum*
d. *Nuclear polyhedrosis virus*

64. Which proves to be effective biological control for nematodal pathogens of plants? *(2008)*
a. *Pseudomonas cepacia* b. *Pistolithus tinctorius*
c. *Gliocladium virens* d. *Paecilomyces lilacinus*

65. Which one of the following pairs is not correctly matched? *(2004)*
a. *Serratia* - Drug addiction
b. *Spirulina* - Single cell protein
c. *Rhizobium* - Biofertiliser
d. *Streptomyces* - Antibiotic

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66. A free living nitrogen-fixing cyanobacterium which can also form symbiotic association with the water fern *Azolla* is: [OS] *(2004)*
a. *Chlorella* b. *Nostoc*
c. *Anabaena* d. *Tolypothrix*

67. Which of the following is the pair of biofertilisers? *(2001)*
a. *Azolla* and IIGA
b. *Nostoc* and legume
c. *Rhizobium* and grasses
d. *Salmonella* and *E. coli*

68. Aquatic fern is used to increase the yield in paddy crop: [OS] *(2000)*
a. *Azolla* b. *Salvinia*
c. *Marsella* d. *Isoetes*

69. Most stable pesticides: [OS]*(1999)*
a. Organophosphates b. Organochlorines
c. Bordeaux mix. d. Azadirachtin

70. *Anabaena* is associated with *Azolla's*: *(1999)*
a. Stem b. Leaves
c. Roots d. Flowers

71. *Azolla* is used in the cultivation of: *(1999)*
a. Maize b. Sorghum
c. Wheat d. Rice

72. Modern farmer's can increase the yield of paddy upto 50% by the use of: *(1998)*
a. Cyanobacteria
b. *Rhizobium*
c. Cyanobacteria in *Azolla pinnata*
d. Farm yard manure

73. The biofertilisers are: *(1997)*
a. *Anabaena* and *Azolla*
b. Cow dung, Manure and farmyard waste
c. Quick growing crop ploughed under soil
d. None of these

74. Cochineal insects have proved very useful for: [OS]*(1996)*
a. Cactus prevention b. *Elchhornia* prevention
c. Weeds control d. *Parthenium* control

75. When a natural predator (living being) is applied on the other pathogen organism to control them, this process is called *(1996)*
a. Artificial control b. Confusion technique
c. Biological control d. Genetic engineering

76. The rotenone is: [OS]*(1995)*
a. A natural herbicide b. A natural insecticide
c. An insect hormone d. A bioherbicide

77. One of the major difficulties in the biological control of insect pest is that: *(1995)*
a. The method is less effective as compared with the use of insecticides
b. The practical difficulty of introducing the predator to specific areas
c. The predator develops a preference to other diets and may itself become a pest
d. The predator does not always survive when transferred to a new environment

78. Biological control of agricultural pests, unlike chemical control, is: *(1994)*
a. Self perpetuating b. Polluting
c. Very expensive d. Toxic

79. Which of the following species does not have the ability to fix atmospheric nitrogen? *(1994)*
a. *Azotobacter* b. *Anabaena*
c. *Nostoc* d. *Spirogyra*

Answer Key

			4. (d)	5. (c)	6. (b)	7. (b)	8. (c)	9. (d)	10. (d)
11. (d)	12. (d)	13. (b)	14. (b)	15. (a)	16. (d)	17. (c)	18. (a)	19. (d)	20. (b)
21. (d)	22. (c)	23. (a)	24. (b)	25. (b)	26. (c)	27. (a)	28. (a)	29. (b)	30. (b)
31. (a)	32. (b)	33. (c)	34. (b)	35. (d)	36. (c)	37. (c)	38. (c)	39. (b)	40. (a)
41. (a)	42. (a)	43. (b)	44. (c)	45. (a)	46. (b)	47. (a)	48. (c)	49. (d)	50. (c)
51. (a)	52. (b)	53. (d)	54. (c)	55. (b)	56. (a)	57. (b)	58. (b)	59. (a)	60. (c)
61. (c)	62. (b)	63. (a)	64. (d)	65. (a)	66. (c)	67. (a)	68. (a)	69. (b)	70. (b)
71. (d)	72. (c)	73. (a)	74. (a)	75. (c)	76. (b)	77. (d)	78. (a)	79. (d)	

Explanations

1. **(b)** Cyclosporin A is a bioactive substance. It is used as an immunosuppressive agent in organ-transplant patients and is produced by the fungus *Trichoderma polysporum*.
Aspergillus niger (a fungus) is involved in the production of citric acid.
Streptococcus cerevisiae is used for commercial production of ethanol.
Clostridium butylicum (a bacterium) is involved in the production of butyric acid.

2. **(d)** *Aspergillus niger* (a fungus)– Citric acid
Acetobacter aceti (a bacterium)– Acetic acid
Clostridium butylicum (a bacterium)– Butyric acid
Lactobacillus (a bacterium)– Lactic acid

3. **(a)** *Clostridium butylicum* - Butyric acid
Trichoderma polysporum - Cyclosporin-A
Monascus purpureus - Blood cholesterol lowering agent
Aspergillus niger - Citric acid

4. **(d)** *Aspergillus niger* (a fungus) is used for the commercial and industrial production of citric acid.

5. **(c)** A bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*.

6. **(b)** Microbes are used in production of several household and industrial products. E.g.,
Lactobacillus – Production of curd
Saccharomyces cerevisiae – Bread making
Aspergillus niger – Citric acid production
Acetobacter aceti – Acetic acid production

7. **(b)**
- Statin is produced by a yeast (fungi) called *Monascus purpureus*. It have been commercialised as blood-cholesterol lowering agent.
- It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

8. **(c)** Content of vitamin - B_{12} increases the conversion of milk into curd.

9. **(d)** *Saccharomyces cerevisiae* is commonly called Brewer's yeast. It causes fermentation of carbohydrates producing ethanol.

10. **(d)** *Aspergillus niger* (a fungus) produces citric acid and *Clostridium butylicum* (a bacterium) produces butyric acid

Statins, produced by the yeast *Monascus purpureus*, have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

Cyclosporin A, which is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*.

11. **(d)** *Clostridium butylicum* (a bacterium) produces butyric acid.

12. **(d)**

Saccharomyces cerevisiae	-	Commercial production of ethanol
Monascus purpureus	-	Production of blood cholesterol lowering agents
Trichoderma polysporum	-	Production of immunosuppressive agents
Propionibacterium sharmanii	-	Ripening of Swiss cheese

13. **(b)**

14. **(b)** Colostrum → rich in antibody.
Chikungunya → caused by arbovirus
Beer → without fermented grape juice.

15. **(a)** Statins produced by the yeast *Monascus purpureus* have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

16. **(d)** Yeast *Saccharomyces cerevisiae* used for bread-making and commonly called brewer's yeast, is used for fermenting malted cereals and fruit juices, to produce ethanol.

17. **(c)** Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

18. **(a)** *Clostridium butylicum* (a bacteria) is butyric acid producer.

19. **(d)** A bioactive molecule, Cyclosporin A, is used as an immunosuppressive agent in organ-transplant patients and it is produced by the fungus *Trichoderma polysporum*.

20. **(b)** Alcohol can be produced by fermentation of sugars present in malted cereals and fruit juices by the action of yeast *Saccharomyces cerevisiae*.

21. **(d)** Enzymes used in detergents are able to perform the task of cleanliness in the presence of cationic and anionic detergents.

22. **(c)** Coliforms are aerobes or facultative anaerobic gram negative, non-endospore forming rod shaped bacteria that ferment lactose to form gas.

23. **(a)** Probiotic is a microbial preparation that helps to establish a population of beneficial microorganisms in the body to maintain health.

24. **(b)** Barley seeds are rich in carbohydrates (starch). The starch is hydrolysed by α-amylase to monosaccharides at the time of seed germination.

25. **(b)** Anaerobic butyric acid bacteria such as *Clostridium botulinum* facilitates retting by decomposing the plant pectin.

26. **(c)** Selman Waksman, a microbiologist discovered streptomycin and first used the work 'antibiotic' in 1943.

27. **(a)** Pathogenic *Aspergillus* sp. produce mycotoxins, well known for their strong and varied biological activities. *Aspergillus flavus* colonise the cereal grains, legumes & tree nuts, and produce highly carcinogenic aflatoxins.

28. **(a)** The bread is fermented by yeast. It becomes porous due to the production of CO_2 gas.

29. **(b)** Ethanol for beverages is derived by the fermentation of starch and yeast used in this process is *Saccharomyces cerevislae*, also called brewer's yeast.

30. **(b)** *Aspergillus niger* is a haploid filamentous fungi produces organic acids such as citric acid & gluconic acid by fermentation.

31. **(a)** *S.cerevisiae*, also called brewer's yeast as it is used in beverage industries to produce ethanol by fermenting various organic compounds.

32. **(b)** Antibiotics are capable of curing disease caused by bacterial infections.

33. **(c)** *A. niger* produces citric acid by fermentation.

34. **(b)** *Saccharomyces cerevistae* is used in beverage industries for alcohol fermentation as in anaerobic condition it ferment the compounds to form ethanol.

35. **(d)** Microbes used in cheese manufacturing play an important role in initial cheese ripening, souring and flavouring.

36. **(c)** Bacteria grow and divide very rapidly so they prone to new mutation and develop into new strains. Consequent exposure of bacteria to antibiotics result in some changes in population which is beneficiary in terms of their survival. These changes lead to development of new, antibiotic resistant strains.

37. **(c)** After significant reduction of BOD of sewage or waste wate, the effluent is passed in a settling tank. The bacterial flocs are allowed to sediment in this tank. This sediment is called activated sludge. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters.

38. **(c)** Primary treatment is a physical process which involves sequential filtration and sedimentation.

39. **(b)** Biogas is a mixture of gases containing predominantly methane, hydrogen sulphide and carbon dioxide.

40. **(a)** Marsh gas is also known as methane and it is mainly produced by the activity of anaerobic bacteria on sewage

41. **(a)** Micro-organisms usually use aerobic metabolism to degrade the biological matter in the liquid sludge during sewage treatment.

42. **(a)** BOD: Amount of oxygen required by bacteria to break down the organic matter present in a certain time in a certain volume of a sample of water.

BOD ∝ amount of organic matter

43. **(b)** Gobar gas constitutes 75% methane, along with CO_2 & H_2

44. **(c)** Activated sludge is a rich source of aerobic bacteria. Biogas contain CH_4, CO_2, H_2S and SO_2 gases. Biogas produced by *Methanobacterium* which respires anaerobically

45. **(a)** Gobar gas contains 75% methane, along with CO_2 and H_2

46. **(b)** Lignin is a complex organic polymer acts as a structural framework of tissues of vascular plants. It is not composed of carbohydrate monomers but is a cross - linked phenolic polymer that is left undegraded during anaerobic digestion.

47. **(a)** Methanogens belong to archaea and are famous for producing methane as a metabolic byproduct in anoxic conditions, as in biogas plant.

48. **(c)** Methanogens produces the methane gas in anaerobic condition by fermenting the cow dung.

49. **(d)** Biogas contains methane & carbon dioxide, formed by the action of microbes on cow dung.

50. **(c)** Dragonflies are useful to get rid of mosquitoes.

Bacillus thuringiensis is an example of microbial biocontrol agents that can be introduced in order to control butterfly caterpillars and lepidopteran plant pests.

Many members of the genus *Glomus* form mycorrhiza. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant.

Baculoviruses are pathogens that attack insects and other arthropods. These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications.

51. **(a)** Fungus *Trichoderma* is a biological control agent being developed for use in the treatment of plant diseases.

52. **(b)** Fungus *Trichoderma*, Baculoviruses (NPV) and *Bacillus thuringiensis* are used as biocontrol agents.

Rhizobium, *Nostoc*, *Azospirillum* and *Oscillatoria* are used as biofertilisers, whereas TMV is a pathogen and aphids are pests that harm crop plants.

53. **(d)** Many members of the genus *Glomus* form mycorrhiza. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant.

54. **(c)** Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments, many of which can fix atmospheric nitrogen.

E.g. *Anabaena*, *Nostoc*, *Oscillatoria*, etc.

55. **(b)** A biological control being developed for use in the treatment of plant disease is the fungus *Trichoderma*. *Trichoderma* species are free-living fungi that are very common in the root ecosystems.

56. **(a)** Only statement B & C are correct.

In organic farming, only natural manure/compost is used. Chemical pesticides like urea /DDT etc are not used in organic farming.

57. **(b)** Many members of the genus *Glomus* form Mycorrhiza. The fungal symbionts in these associations absorb phosphorus from soil and pass it to the plant.

58. **(b)** *Agrobacterium tumifaciens*, a pathogen of several dicot plants is able to deliver a piece of DNA known as 'T-DNA' to transform normal plant cells into a tumor and direct these tumor cells to produce the chemicals required by the pathogen.

59. **(a)** *Glomus* genus of fungi forms symbiotic associations with plants and is an endomycorrhiza. It absorbs phosphorus from the soil and passes it to the plant.

60. **(c)** *Trichoderma* species are free living fungi that are very common in the root ecosystems. They are effective biocontrol agents against several plant pathogens.

61. **(c)** Earthworm causes fragmentation of soil. *Oscillatoria* serve as a biofertiliser. It fixes N_2 from atmosphere. Fungi *Glomus* supply phosphorus to plant.

62. **(b)** *Oscillatoria* is a cyanobacteria commonly serve as biofertiliser in paddy fields.

63. **(a)** Bacterium *Xanthomonas campestris* is the causative agent of plant disease, e.g., black rot of cabbage.

64. **(d)** *Paecilomyces lilacinus* is easily produced *in vitro*. Rhizosphere competent attack the eggs of several nematode species and treatment of plant matter.

65. **(a)** *Serratia* is a genus of Gram -negative bacteria, that causes nosocomial infections.

66. **(c)** N_2 - fixing cyanobacterium *Anabaena* along with fern *Azolla* sp. serve as a good biofertiliser. Together as symbionts, they increase the yield of paddy fields.

67. **(a)** *Azolla* in symbiosis with *Anabaena* is used as biofertlilser in rice fields.

68. **(a)** *Azolla* is a floating fern, which has been used to control mosquito larvae in rice fields. It contains cyanobacteria *Anabaena* as endosymbiont that fixes the N_2 & improve the fertility of rice paddy fields.

69. **(b)** Organochlorines are pesticides that have chlorinated aromatic molecules. They belong to the class of persistent organic pollutants.

70. **(b)** *Anabaena* lives within the ovoid cavities inside the leaves of *Azolla*, the fern.

71. **(d)** *Azolla* is a floating pteridophyte that contains N_2 fixing cyanobacterium *Anabaena* as endosymbiont. Due to this ability of endosymbiosis, *Azolla* is extensively grown in rice fields.

72. **(c)** *Azolla* is a floating fern, which contains N_2 - fixing cyanobacterium *Anabaena* as endosymbiont. It has been used to control mosquito larvae in rice fields and cyanobacteria fixed the atmospheric nitrogen and improve the fertility of rice paddy fields.

73. **(a)** *Anabaena* is N_2-fixing bacterial that lives as endosymbiont with *Azolla* fern and together acts as biofertilisers in rice fields.

74. **(a)** Cochineal insects are found on the pads of prickly pear cacti. They penetrate the cactus with their beak-like mouth parts and feed on its juices.

75. **(c)** Biological control is a method of controlling pests by relying on predation, parasitism or other natural mechanism.

76. **(b)** Natural insecticides are those which are obtained from microorganisms and plants. The first natural insecticide used by man is azadirachtin obtained from *Azadirachta indica*.

77. **(d)** Biocontrol method depends on predatism. Sometimes predator does not be able to survive in the new environment and hence cannot prey on the insects.

78. **(a)** Amount and order of introduction of chemical pesticide must be highly regulated and maintained, on the other hand, biocontrol method is self-perpetuating once it is introduced.

79. **(d)** *Spirogyra*, a green algae found in freshwater ditches does not have the ability to fix atmospheric nitrogen.

CHAPTER 9

Biotechnology: Principles and Processes

Principles of Biotechnology

1. Pathogenic bacteria gain resistance to antibiotics due to changes in their: *(2022 Re)*
   a. Nucleoid b. Cosmids
   c. Plasmids d. Nucleus
2. Which of the following methods is not commonly used for introducing foreign DNA into the plant cell? *(2022 Re)*
   a. Bacteriophages
   b. Agrobacterium mediated transformation
   c. Gene gun
   d. 'Disarmed pathogen' vectors
3. The cutting of DNA at specific locations became possible with the discovery of: *(2015 Re)*
   a. Probes b. Selectable markers
   c. Ligases d. Restriction enzymes
4. Which one of the following techniques made it possible to genetically engineer living organisms? *(2011 Mains)*
   a. Heavier isotope labeling
   b. Hybridisation
   c. Recombinant DNA techniques
   d. X-ray diffraction
5. Which is used in gene cloning? *(2010 Mains)*
   a. Lomasomes b. Mesosomes
   c. Plasmids d. Nucleotides
6. Maximum application of animal cell culture technology today is in the production of: *(2003)*
   a. Insulin b. Interferons
   c. Vaccines d. Edible proteins
7. Chromosomes in a bacterial cell can be 1-3 in number and: *(2003)*
   a. Are always circular
   b. Are always linear
   c. Can be either circular or linear, but never both within the same cell
   d. Can be circular as well as linear within the same cell
8. Manipulation of DNA in genetic engineering became possible due to the discovery of: *(2002)*
   a. Restriction endonuclease
   b. DNA ligase
   c. Transcriptase
   d. Primase
9. DNA of *E. Coli*: *(1998)*
   a. ds circular b. ss circular
   c. ds Linear d. ss Linear
10. Knife of DNA: *(1998)*
    a. DNA-ligase
    b. Restriction endonuclease
    c. Exonuclease
    d. Peptidase
11. Genetic engineering involves: *(1998)*
    a. Use of restriction endonuclease on bacterial DNA and formation of new traits
    b. Use of ligase for cutting DNA
    c. Developing instruments
    d. Use of statistic in genetics
12. Which of the following most used in genetic engineering? *(1998)*
    a. *E. coil* and *Agrobacterium*
    b. *Mycobacteria* and *Salmonella*
    c. *Aspergillus*
    d. *Penicillium*
13. The restriction enzymes are used in genetic engineering because: *(1995)*
    a. They can cut DNA at specific base sequence
    b. They are nucleases that cut DNA at variable sites
    c. They can degrade harmful proteins
    d. They can join different DNA fragments
14. Which of the following organelles is related with genetic engineering? *(1994)*
    a. Mitochondria b. Plasmids
    c. Golgi bodies d. Lysosomes

Tools of Recombinant DNA Technology

15. Upon exposure to UV radiation, DNA stained with ethidium bromide will show *(2023)*
    a. Bright orange colour b. Bright red colour
    c. Bright blue colour d. Bright yellow colour
16. In gene gun method used to introduce alien DNA into host cells, microparticles of _____ metal are used. *(2023)*
    a. Silver b. Copper
    c. Zinc d. Tungsten or gold
17. Which of the following is not a cloning vector? *(2023)*
    a. Probe b. BAC
    c. YAC d. pBR322
18. Ligation of foreign DNA at which of the following site will result in loss of tetracycline resistance of pBR322: *(2023-Manipur)*
    a. *Pst* I b. *Pvu* I
    c. *Eco*R I d. *Bam*H I
19. Match **List-I** with **List-II**. **[MR^3]** *(2023-Manipur)*

List-I		List-II	
(A)	Kanamycin	(I)	Delivers genes into animal cells
(B)	*Cla*I	(II)	Selectable marker
(C)	Disarmed retroviruses	(III)	Restriction site
(D)	Kanamycin ^{R}gene	(IV)	Antibiotic resistance

Choose the **correct** answer from the options given below:
   a. A-II, B-III, C-I, D-IV b. A-III, B-I, C-IV, D-II
   c. A-IV, B-III, C-I, D-II d. A-II, B-IV, C-I, D-III
20. Which of the following can act as molecular scissors? *(2023-Manipur)*
    a. Restriction enzymes b. DNA ligase
    c. RNA polymerase d. DNA polymerase
21. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). *(2022 Re)*

Assertion (A): When a particular restriction enzyme cuts strand of DNA, overhanging stretches or sticky ends are formed.

Reason (R): Some restriction enzymes cut the strand of DNA a little away from the centre of the palindromic site.

In the light of the above statements, choose the correct answer from the options given below
   a. (A) is not correct but (R) is correct
   b. Both (A) and (R) are correct and (R) is the correct explanation of (A)
   c. Both (A) and (R) are correct but (R) is not the correct explanation of (A)
   d. (A) is correct but (R) is not correct

22. Separation of DNA fragments is done by a technique known as *(2022 Re)*
    a. Gel electrophoresis
    b. Polymerase Chain Reaction
    c. Recombinant technology
    d. Southern blotting
23. In the following palindromic base sequences of DNA, which one can be cut easily by particular restriction enzyme? *(2022)*
    a. 5'GTATTC3';3'CATAAG5'
    b. 5'GATACT3';3'CTATGA5'
    c. 5'GAATTC3';3'CTTAAG5'
    d. 5'CTCAGT3';3'GAGTCA5'
24. Which of the following is not a desirable feature of a cloning vector? *(2022)*
    a. Presence of two or more recognition sites
    b. Presence of origin of replication
    c. Presence of a marker gene
    d. Presence of single restriction enzyme site
25. Given below are two statements:

Statement I: Restriction endonucleases recognise specific sequence to cut DNA known as palindromic nucleotide sequence.

Statement II: Restriction endonucleases cut the DNA strand a little away from the centre of the palindromic site

In the light of the above statements, choose the most appropriate answer from the options given below.
   a. Statement I is incorrect but Statement II is correct
   b. Both Statement I and Statement II are correct
   c. Both statement I and statement II are incorrect
   d. Statement I is correct but Statement II is incorrect
26. DNA strands on a gel stained with ethidium bromide when viewed under UV radiation, appear as: *(2021)*
    a. Bright orange bands b. Dark red bands
    c. Bright blue bands d. Yellow bands
27. Plasmid pBR322 has PstI restriction enzyme site within gene amp^R that confers ampicillin resistance, If this enzyme is used for inserting a gene for β- galactoside production and the recombinant plasmid is inserted in an *E.coli* strain **[MR^3]** *(2021)*
    a. The transformed cells will have the ability to resist ampicillin as well as produce β-galactoside.
    b. It will lead to lysis of host cell.
    c. It will be able to produce a novel protein with dual ability.
    d. It will not be able to confer ampicillin resistance to host cell.
28. A specific recognition sequence identified by endonucleases to make cuts at specific positions within the DNA is: *(2021)*
    a. Okazaki sequences
    b. Palindromic Nucleotide sequences
    c. Poly (A) tail sequences
    d. Degenerate primer sequence

29. First discovered restriction endonuclease that always cuts DNA molecule at a particular point by recognising a specific sequence of six base pairs is: *(2020-Covid)*

a. Adenosine deaminase
b. Thermostable DNA polymerase
c. Hind II
c. EcoRI

30. Match the organism with its use in biotechnology. [MR*] *(2020)*

1.	*Bacillus thuringiensis*	(i)	Cloning vector
2.	*Thermus aquaticus*	(ii)	Construction of first rDNA molecule
3.	*Agrobacterium tumifaciens*	(iii)	DNA polymerase
4.	*Salmonella typhimurium*	(iv)	Cry proteins

Select the correct option from the following

a. 1-(iv) 2-(iii) 3-(i) 4-(ii)
b. 1-(iii) 2-(ii) 3-(iv) 4-(i)
c. 1-(iii) 2-(iv) 3-(i) 4-(ii)
d. 1-(ii) 2-(iv) 3-(iii) 4-(i)

31. The sequence that controls the copy number of the linked DNA in the vector, is termed: *(2020)*

a. *Ori* site b. Palindromic sequence
c. Recognition site d. Selectable marker

32. The specific palindromic sequence which is recognized by *Eco*RI is: *(2020)*

a. 5' - GGAACC - 3' b. 5' - CTTAAG - 3'
3' - CCTTGG - 5' 3' - GAATTC - 5'
c. 5' - GGATCC - 3' d. 5' - GAATTC - 3'
3' - CCTAGG - 5' 3' - CTTAAG - 5'

Identify the wrong statement with regard to restriction enzymes. *(2020)*

a. They cut the strand of DNA at palindromic sites.
b. They are useful in genetic engineering.
c. Sticky ends can be joined by using DNA ligases.
d. Each restriction enzyme functions by inspecting the length of a DNA sequence.

Choose the correct pair from the following: [MR*] *(2020)*

a.	Polymerases	-	Break the DNA into fragments
b.	Nucleases	-	Separate the two strands of DNA
c.	Exonucleases	-	Make cuts at specific positions within DNA
d.	Ligases	-	Join the two DNA molecules

35. Following statements describe the characteristics of the enzyme restriction endonuclease. Identify the incorrect statement. *(2019)*

a. The enzyme cuts DNA molecule at identified position within the DNA.
b. The enzyme binds DNA at specific sites and cuts only one of the two strands.
c. The enzyme cuts the sugar-phosphate backbone at specific sites on each strand.
d. The enzyme recognizes a specific palindromic nucleotide sequence in the DNA.

36. A gene whose expression helps to identify transformed cell is known as *(2017-Delhi)*

a. Selectable marker b. Vector
c. Plasmid d. Structural gene

37. Restriction endonucleases are: *(2017-Gujarat)*

a. Used in genetic engineering for ligating two DNA molecules
b. Used for in vitro DNA synthesis
c. Synthesised by bacteria as part of their defense mechanism
d. Present in mammalian cell for degradation of DNA when the cell dies

38. Which of the following restriction enzymes produces blunt ends? [OS]*(2016 - II)*

a. *Xho* I b. *Hind* III
c. *Sal* I d. *Eco* RV

39. A foreign DNA and plasmid cut by the same restriction endonuclease can be joined to form a recombinant plasmid using: *(2016 - II)*

a. Polymerase-III b. Ligase
c. *Eco* RI d. Taq polymerase

40. Which of the following is a restriction endonuclease? *(2016 - I)*

a. *Hind* II b. Protease
c. DNase I d. RNase

41. Which of the following is not a feature of the plasmids? *(2016 - I)*

a. Independent replication b. Circular structure
c. Transferable d. Single-stranded

42. The DNA molecule to which the gene of interest is integrated for cloning is called: *(2015 Re)*

a. Vector b. Template
c. Carrier d. Transformer

43. The introduction of t-DNA into plants involves: *(2015 Re)*

a. Altering the pH of the soil, then heat shocking the plants
b. Exposing the plants to cold for a brief period
c. Allowing the plant roots to stand in water
d. Infection of the plant by *Agrobacterium tumifaciens*

44. Which vector can clone only a small fragment of DNA? *(2014)*

a. Cosmid
b. Bacterial artificial chromosome
c. Yeast artificial chromosome
d. Plasmid

45. DNA fragments generated by the restriction endonuclease in a chemical reaction can be separated by: *(2013)*

a. Restriction mapping
b. Centrifugation
c. Polymerase chain reaction
d. Electrophoresis

46. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of: *(2013)*

a. Inactivation of glycosidase enzyme in recombinant bacteria
b. Non-recombinant bacteria containing betagalactosidase
c. Insertional inactivation of alpha-galactosidase in non-recombinant bacteria
d. Insertional inactivation of beta-galactosidase in recombinant bacteria

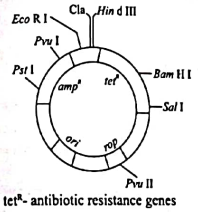
47. Which one of the following represents a palindromic sequence in DNA? *(2012 Mains)*

a. 5' - GAATTC - 3'
3' - CTTAAG - 5'
b. 5' - CCAATG - 3'
3' - CAATCC - 5'
c. 5' - CATTAG - 3'
3' - GATAAC - 5'
d. 5' - GATACC - 3'
3' - CCTAAG - 5'

48. In genetic engineering, the antibiotics are used: *(2012 Mains)*

a. As selectable markers
b. To select healthy vectors
c. As sequences from where replication starts
d. To keep the cultures free of infection

49. The figure below is the diagrammatic representation of the *E.coli* vector pBR 322. Which one of the given options correctly identifies its certain component (s)? *(2012 Pre)*



a. amp^R, tet^R- antibiotic resistance genes
b. ori-original restriction enzyme
c. rop-reduced osmotic pressure
d. *Hind* III, *Eco*RI-selectable markers

50. Which one of the following is a case of wrong matching? [MR*] *(2012 Pre)*

a. Callus - Unorganised mass of cells produced in tissue culture
b. Somatic hybridisation - Fusion of two diverse cells
c. Vector DNA - Site for t-RNA synthesis
d. Micropropagation - *In vitro* production of plants in large numbers

51. There is a restriction endonuclease called *Eco*RI. What does "co" part in it stand for? *(2011 Pre)*

a. *coli* b. Colon
c. Coelom d. Coenzyme

52. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special shown in it? *(2011 Pre)*

5' _____ GAATTC _____ 3'
3' _____ CTTAAG _____ 5'

a. Palindromic sequence of base pairs
b. Replication completed
c. Deletion mutation
d. Start codon at the 5' end

53. Which one of the following is used as vector for cloning into higher organisms? *(2010 Pre)*

a. *Salmonella typhimurium*
b. *Rhizopus nigricans*
c. Retrovirus
d. *Baculovirus*

54. Which can be used as vector for transfer of DNA segment? *(2010 Mains)*

A. Bacterium
B. Plasmid
C. Plasmodium
D. Bacteriophage

a. A, B and D b. A only
c. A and C d. B and D

55. Restriction endonucleases: *(2004)*

a. Are used in genetic engineering for ligating two DNA molecules
b. Are used for in vitro DNA synthesis
c. Are synthesised by bacteria as part of their defense mechanism
d. Are present in mammalian cells for degradation of DNA when the cell dies

56. The Ti plasmid is often used for making transgenic plants. This plasmid is found in: *(2004)*

a. *Rhizobium* of the roots of leguminous plants
b. *Agrobacterium*
c. Yeast as a 2 µm plasmid
d. *Azotobacter*

57. Which one of the following bacteria has found extensive use in genetic engineering work in plants: *(2003)*

a. *Clostridium septicum* b. *Xanthomonas citri*
c. *Bacillus coagulens* d. *Agrobacterium tumefaciens*

58. What is true for plasmid? *(2001)*

a. Plasmids are widely used in gene transfer
b. These are found in virus
c. Plasmid contain gene for vital activities
d. These are main part of chromosome

59. Which of the following cut the DNA from specific places? *(2001)*

a. Restriction endonuclease (*Eco*RI)
b. Ligase
c. Exonuclease
d. Alkaline phosphate

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60. A mutant strain of T_4 — bacteriophage, R-II, fails to lyse the *E. Coli* but when two strains R-II^a and R-II^b are mixed then they lyse the *E. Coli*. What may be the possible reason? *(2001)*

a. Bacteriophage transforms in wild
b. It is not mutated
c. Both strains have similar cistrons
d. Both strains have different cistrons

61. The bacteria generally used for genetic engineering is: *(2000)*

a. *Agrobacterium* b. *Bacillus*
c. *Pseudomonas* d. *Clostridium*

62. Plasmid has been used as vector because: *(2000)*

a. It is circular DNA which have capacity to join to eukaryotic DNA
b. It can move between prokaryotic and eukaryotic cells
c. Both ends show replication
d. It has antibiotic resistance gene

63. *E. coli* are used in production of: *(1999)*

a. Rifampicin b. LH
c. Ecdyson d. Interferon

64. Function of nucleases: *(1999)*

a. Break the polynucleotide chain by breaking the each terminal nucleotide
b. Breaks phosphodiester bond
c. Breaks peptide bonds
d. Breaks ester bonds

The nuclease enzyme, which begins its attack from free end of a polynucleotide, is: *(1994)*

a. Polymerase b. Endonuclease
c. Exonuclease d. Kinase

Processes of Recombinant DNA Technology

During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out *(2023)*

a. Polysaccharides b. RNA
c. DNA d. Histones

67. Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence [MR*] *(2023)*

A. Insertion of recombinant DNA into the host cell.
B. Cutting of DNA at specific location by restriction enzyme.
C. Isolation of desired DNA fragment.
D. Amplification of gene of interest using PCR.

Choose the correct answer from the option given below:

a. B, D, A, C b. B, C, D, A
c. C, A, B, D d. C, B, D, A

68. Thermostable DNA polymerase used in PCR was isolated from: *(2023-Manipur)*

a. *Thermus aquaticus*
b. *Escherichia coli*
c. *Agrobacterium tumifaciens*
d. *Bacillus thuringiensis*

69. The enzyme (a) is needed for isolating genetic material from plant cells and enzyme (b) for isolating genetic material from fungus. Choose the correct pair of options from the following: *(2022 Re)*

a. (a) Cellulase (b) Lipase
b. (a) Cellulase (b) Protease
c. (a) Cellulase (b) Chitinase
d. (a) Chitinase (b) Lipase

70. Refer to the following statements for agarose gel electrophoresis: *(2022 Re)*

A. Agarose is a natural polymer obtained from sea-weed.
B. The separation of DNA molecules in agarose-gel electrophoresis depends on the size of DNA.
C. The DNA migrates from negatively-charged electrode to the positively-charged electrode
D. The DNA migrates from positively-charged electrode to the negatively-charged electrode.

Choose the **most appropriate** answer from the options given below

a. (B), (C) and (D) only b. (A) and (B) only
c. (A), (B) and (C) only d. (A), (B) and (D) only

71. Which one of the following statement is **not true** regarding gel electrophoresis technique? *(2022)*

a. Bright orange coloured bands of DNA can be observed in the gel when exposed to UV light.
b. The process of extraction of separated DNA strands from gel is called elution.
c. The separated DNA fragments are stained by using ethidium bromide.
d. The presence of chromogenic substrate gives blue coloured DNA bands on the gel

72. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). [MR*] *(2022)*

Assertion (A): Polymerase chain reaction is used in DNA amplification

Reason (R): The ampicillin resistant gene is used as a selectable marker to check transformation

In the light of the above statements, choose the correct answer from the options given below.

a. (A) is not correct but (R) is correct
b. Both (A) and (R) are correct and (R) is the correct explanation of (A)
c. Both (A) and (R) are correct but (R) is not the correct explanation of (A)
d. (A) is correct but (R) is not correct

73. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out: *(2021)*

a. DNA b. Histones
c. Polysaccharides d. RNA

74. During the process of gene amplification using PCR, if very high temperature is not maintained in the beginning, then which of the following steps of PCR will be affected first? *(2021)*

a. Extension b. Denaturation
c. Ligation d. Annealing

75. In gel electrophoresis, separated DNA fragments can be visualized with the help of: *(2020)*

a. Ethidium bromide in UV radiation
b. Acetorarmine in UV radiation
c. Ethidium bromide in infrared radiation
d. Acetocarmine in bright blue light

76. In a mixture, DNA fragments are separated by *(2020-Covid)*

a. Restriction digestion
b. Electrophoresis
c. Polymerase chain reaction
d. Bioprocess engineering

77. In recombinant DNA technology antibiotics are used: *(2020-Covid)*

a. To detect alien DNA
b. To impart disease-resistance to the host plant
c. As selectable markers
d. To keep medium bacteria-free

78. Match the following techniques or instruments with their usage: [MR*] *(2020-Covid)*

1.	Bioreactor	(i)	Separation of DNA fragments
2.	Electrophoresis	(ii)	Production of large quantities of products
3.	PCR	(iii)	Detection of pathogen, based on antigen-antibody reaction
4.	ELISA	(iv)	Amplification of nucleic acids

Select the correct option from following:

	(1)	(2)	(3)	(4)
a.	(ii)	(i)	(iv)	(iii)
b.	(iv)	(iii)	(ii)	(i)
c.	(ii)	(i)	(iii)	(iv)
d.	(iii)	(ii)	(iv)	(i)

79. Spooling is: *(2020-Covid)*

a. Cutting of separated DNA bands from the agarose gel
b. Transfer of separated DNA fragments to synthetic membranes
c. Collection of isolated DNA
d. Amplification of DNA

80. Select the correct statement from the following: [MR*] *(2020-Covid)*

a. The polymerase enzyme joins the gene of interest and the vector DNA
b. Restriction enzyme digestions are performed by incubating purified DNA molecules with the restriction enzymes of optimum conditions
c. PCR is used for isolation and separation of gene of interest
d. Gel electrophoresis is used for amplification of a DNA segment

81. Which one of the following equipments is essentially required for growing microbes on a large scale, for industrial production of enzymes? *(2019)*

a. BOD incubator b. Sludge digester
c. Industrial oven d. Bioreactor

82. DNA precipitation out of a mixture of biomolecules can be achieved by treatment with *(2019)*

a. Isopropanol
b. Chilled ethanol
c. Methanol at room temperature
d. Chilled chloroform

83. The correct order of steps in Polymerase Chain Reaction (PCR) is: *(2018)*

a. Extension, Denaturation, Annealing
b. Annealing, Extension, Denaturation
c. Denaturation, Extension, Annealing
d. Denaturation, Annealing, Extension

84. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis? *(2017-Delhi)*

a. The larger the fragment size, the farther it moves
b. The smaller the fragment size, the farther it moves
c. Positively charged fragments move to farther end
d. Negatively charged fragments do not move

85. The process of separation and purification of expressed protein before marketing is called *(2017-Delhi)*

a. Upstream processing b. Downstream processing
c. Bioprocessing d. Postproduction processing

86. The DNA fragments separated on an agarose gel can be visualised after staining with: *(2017-Delhi)*

a. Bromophenol blue b. Acetocarmine
c. Aniline blue d. Ethidium bromide

87. Which of the following is not a component of downstream processing? *(2016 - II)*

a. Preservation b. Expression
c. Separation d. Purification

88. Stirred-tank bioreactors have been designed for: *(2016 - II)*

a. Availability of oxygen throughout the process
b. Ensuring anaerobic conditions in the culture vessel
c. Purification of product
d. Addition of preservatives to the product

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89. The *Taq* polymerase enzyme is obtained from: *(2016 - I)*

a. *Thermus aquaticus* b. *Thiobacillus ferrooxidans*
c. *Bacillus subtilis* d. *Pseudomonas putida*

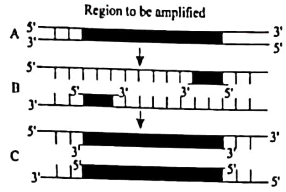
90. *In vitro* clonal propagation in plants is characterised by: *(2014)*

a. Microscopy b. PCR and RAPD
c. Northern blotting d. Electrophoresis and HPLC

91. Which of the following is not correctly matched for the organism and its cell wall degrading enzyme? *(2013)*

a. Fungi - Chitinase b. Bacteria - Lysozyme
c. Plant cells - Cellulase d. Algae - Methylase

92. The figure below shows three steps (A, B, C) of Polymerase Chain Reaction (PCR). Select the option giving correct identification together with what it represents? [MR*] *(2012 Mains)*



a. B-Denaturation at a temperature of about 90°C separating the two DNA strands
b. A - Denaturation at a temperature of about 50°C
c. C - Extension in the presence of heat stable DNA polymerase
d. A - Annealing with two sets of primers

93. Biolistics (gene-gun) is suitable for: *(2012 Mains)*

a. Disarming pathogen vectors
b. Transformation of plant cells
c. Constructing recombinant DNA by joining with vectors
d. DNA fingerprinting

94. Which one is a true statement regarding DNA Polymerase used in PCR? *(2012 Pre)*

a. It remains active at high temperature
b. It is used to ligate introduced DNA in recipient cells
c. It serves as a selectable marker
d. It is isolated from a virus

95. For transformation, micro-particles coated with DNA to be bombarded with gene gun are made up of: *(2012 Pre)*

a. Gold or Tungsten b. Silver or Platinum
c. Platinum or Zinc d. Silicon or Platinum

96. Agarose extracted from sea weeds finds use in: *(2011 Pre)*

a. Gel electrophoresis b. Spectrophotometry
c. Tissue culture d. PCR

97. Continuous addition of sugars in 'fed batch' fermentation is done to: [OS]*(2011 Pre)*

a. Degrade sewage b. Produce methane
c. Obtain antibiotics d. Purify enzymes

98. Stirred-tank bioreactors have been designed for: *(2010 pre)*

a. Purification of the product
b. Ensuring anaerobic conditions in the culture vessel
c. Availability of oxygen throughout the process
d. Addition of preservatives to the product

99. Which of the following enzymes are used to join bits of DNA? *(2002)*

a. Ligase b. Primase
c. DNA polymerase d. Endonuclease

100. Maximum number of bases in plasmids discovered so far: *(2001)*

a. 50 kilo base b. 500 kilo base
c. 5000 kilo base d. 5 kilo base

101. Hybridoma is: [OS]*(1999)*

a. Collection of DNA from DNA
b. Collection of RNA from DNA
c. A fusion of tumour sex cell with non-tumour sex cell
d. A fusion of tumour somatic cell with non-[illegible] cell

Answer Key

1. (c)	**2.** (a)	**3.** (d)	**4.** (c)	**5.** (c)	**6.** (c)	**7.** (a)	**8.**			
11. (a)	**12.** (a)	**13.** (a)	**14.** (b)	**15.** (a)	**16.** (d)	**17.** (a)	**18.** (d)	**19.** (c)	**20.** (a)	
21. (b)	**22.** (a)	**23.** (c)	**24.** (a)	**25.** (b)	**26.** (a)	**27.** (d)	**28.** (b)	**29.** (c)	**30.** (a)	
31. (a)	**32.** (d)	**33.** (c)	**34.** (d)	**35.** (b)	**36.** (a)	**37.** (c)	**38.** (d)	**39.** (b)	**40.** (a)	
41. (d)	**42.** (a)	**43.** (d)	**44.** (d)	**45.** (d)	**46.** (b)	**47.** (a)	**48.** (a)	**49.** (a)	**50.** (c)	
51. (a)	**52.** (a)	**53.** (c)	**54.** (d)	**55.** (c)	**56.** (b)	**57.** (d)	**58.** (a)	**59.** (a)	**60.** (d)	
61. (a)	**62.** (a)	**63.** (d)	**64.** (b)	**65.** (c)	**66.** (c)	**67.** (b)	**68.** (a)	**69.** (c)	**70.** (c)	
71. (d)	**72.** (c)	**73.** (a)	**74.** (b)	**75.** (a)	**76.** (b)	**77.** (c)	**78.** (a)	**79.** (c)	**80.** (b)	
81. (d)	**82.** (b)	**83.** (d)	**84.** (b)	**85.** (b)	**86.** (d)	**87.** (b)	**88.** (a)	**89.** (a)	**90.** (b)	
91. (d)	**92.** (c)	**93.** (b)	**94.** (a)	**95.** (a)	**96.** (a)	**97.** (d)	**98.** (c)	**99.** (a)	**100.** (b)	
101. (d)										

Explanations

1. (c) Specific bacteria gain resistance to antibiotics due to changes in their plasmids. Plasmids can carry genes that confer resistance to antibiotics, and these can be transferred between bacteria, spreading resistance.

2. (a) Bacteriophages are utilized for inserting foreign DNA into bacteria, not plants.

3. (d) In 1963, two enzymes responsible for restricting the bacteriophage growth in bacteria was discovered. Second enzyme cut DNA molecule at a particular point by recognising a specific sequence DNA.

4. (c) Recombinant DNA (rDNA) techniques made it possible to genetically engineer living organisms.

Using rDNA technologies, one can modify or alter the genomic sequence of the organism and create new varieties. Examples: Bt cotton, Bt brinjal etc.

5. (c) Plasmids can carry foreign genes to the host cells for expression of desirable character.

6. (c) Cultured animal cells are used in the production of virus and these viruses are used to produce vaccines. e.g., Vaccines of polio, rabies & chicken pox.

7. (a) Prokaryotic cells contain their chromosome as circular entity. Usually the entire genome is a single molecule of circular DNA but often the number may vary upto three.

8. (a) Restriction endonuclease recognises and cuts at specific sites on DNA strands and form same sticky ends that are cohesive in nature and facilitates the insertion and cloning of gene of interest.

9. (a) *E. coli* has only one circular chromosome, along with a circular plasmid.

10. (b) Knife of DNA is restriction endonuclease that cleaves DNA into fragments at or near specific recognition sites within the molecule.

11. (a) Genetic engineering involves the formation of recombinant DNA molecules by cleaving the insert DNA and vectors from same restriction endonuclease, and joining them together to form insert - vector - DNA.

12. (a) *E.coli* is mostly used as host to multiply and express the desired DNA and *Agrobacterium* is used to transfer genes to plants & fungi.

13. (a) Restriction enzymes recognise the specific sequences and cut at or near these recognition sites. These enzymes form the staggered cuts to produce sticky ends.

14. (b) Plasmids are cytoplasmic organelle found in bacterial cells. They are used as cloning vectors for size of DNA fragments of upto 15 kbp in genetic engineering.

15. (a) In gel electrophoresis the separated DNA fragments can be visualized only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. Bright orange coloured bands of DNA can be seen when stained with ethidium bromide and exposed to UV light.

16. (d) A biolistic or gene gun is a technique of genetic engineering where the genes, DNA, RNA or proteins are transferred to the plant cells without the use of any vectors. The genetic material is coated with heavy metal i.e. gold or tungsten bombarded with the heavy velocity.

17. (a) A probe is not a cloning vector rather it is a single-stranded sequence of DNA or RNA used to search for its complementary sequence in a sample genome.

18. (d) *Bam*H I

The ligation of alien DNA is carried out at a restriction site present in one of the two antibiotic resistance genes. For example, a foreign DNA ligated at the *Bam*H I site of tetracycline resistance gene in the vector pBR322 resulting in the recombinant plasmids will lose tetracycline resistance due to insertion of foreign DNA.

19. (c) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

(A) Kanamycin - (IV) Antibiotic resistance

(B) *Cla*I - (III) Restriction site

(C) Disarmed retroviruses- (I) Delivers genes into animal cells

(D) Kanamycin ʳgene - (II) Selectable marker

20. (a) Restriction enzymes

Restriction enzymes act as molecular scissors by cutting DNA at specific sequences.

21. (b) Sticky ends are generated by restriction enzymes that cleave the DNA strand little away from the centre of the palindromic site but at the corresponding positions on the opposite strand.

22. (a) Gel Electrophoresis technique is used for the separation of DNA fragments based on their size through a gel matrix under the influence of an electric field.

23. (c) A palindromic sequence is defined as a nucleotide sequence in a double-stranded DNA or RNA, when we read it from 5' end to 3' end is the same as that on the complementary strand reading from 3' end to 5' end. Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA.

24. (a) Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning.

25. (b) Each restriction endonuclease functions by 'inspecting' the length of a DNA sequence. Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar -phosphate backbones. Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA. Restriction enzymes cut the strand of DNA a little away from the centre of the palindrome sites, but between the same two bases on the opposite strands.

26. (a) After gel electrophoresis, the fragments of DNA that are separated can be seen under the exposure of UV radiation after staining it with ethidium bromide. This imparts bright orange colour to the fragments.

27. (d) pBR322 is a commonly used cloning vector. Here, gene coding for beta-galactosidase is inserted in the plasmid pBR322 at PstI restriction enzyme site which is responsible for providing resistance toward antibiotic ampicillin. This causes insertional inactivation of the antibiotic resistance gene thus *E.coli* strain will not provide resistance towards the antibiotic ampicillin

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28. (b) Each restriction endonuclease enzyme recognises a specific palindromic nucleotide sequence in the DNA and bind to the DNA. Then, the enzyme cut each of the two strands of the double helix at specific points in their sugar -phosphate backbones.

29. (c) The first restriction endonuclease-*Hind* II, whose functioning depended on a specific DNA nucleotide sequence was isolated and characterised five years later. *Hind* II always cut DNA molecules at a particular point by recognising a specific sequence of six base pairs. This specific base sequence is known as the recognition sequence for *Hind* II

30. (a) *Bacillus thuringiensis* - Source of Cry proteins

Thermus aquaticus - Source of thermostable DNA polymerase (*Taq* polymerase)

Agrobacterium tumefaciens – Cloning vector

Salmonella typhimurium – Used in construction of first rDNA molecule

31. (a) Origin of replication (ori) : This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA.

32. (d) Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA. The specific palindromic sequence which is recognised by EcoRI is

5' - GAATTC - 3'

3' - CTTAAG – 5

33. (c) The sticky ends form hydrogen bonds with their complementary cut counterparts. This stickiness of the ends facilitates the action of the enzyme DNA ligase.

34. (d) Polymerases - Synthesizes long chains of polymers or nucleic acids

Nucleases - Break the DNA into fragments

Helicases - Separate the two strands of DNA

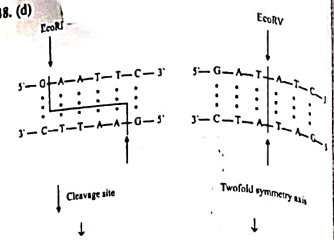
Endonucleases - Make cuts at specific positions within DNA

35. (b) Restriction enzymes cut DNA molecules at a particular point by recognising a specific sequence. Each restriction endonuclease functions by inspecting the length of a DNA sequence. Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar-phosphate backbone.

36. (a) Selectable marker (marker gene): It helps to select the transformants and eliminate the non-transformants.

37. (c) In the bacterial cell, restriction endonuclease recognise and cleaves foreign DNA, thus eliminating infecting

38. (d)



Provide sticky ends — Provide blunt end

39. (b) When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and these can be joined together (end-to-end) using DNA ligases

40. (a) The first restriction endonuclease-*Hind* II.

41. (d) Plasmid is an autonomously, replicating, double-stranded, circular extrachromosomal DNA.

42. (a) The vectors are DNA molecules that can carry a foreign DNA (gene of interest) and replicate inside the host cells. Vectors may be plasmids, a bacteriophage, cosmids, phagemids, YAC, BAC, transposons and virus, etc.

43. (d) *Agrobacterium tumifaciens*, a pathogen of several dicots plants is able to deliver a piece of DNA into the plant cells.

44. (d) Some plasmids have 1 or 2 copies per cell.

45. (d) DNA fragments generated by restriction enzyme are separated by gel electrophoresis.

46. (b) The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of insertional inactivation of beta-galactosidase in non-recombinant bacteria.

47. (a) Following represents a palindromic sequence in DNA:

5' - GAATTC - 3'

3' - CTTAAG - 5'

These sequences read the same on the two strand in 5'→ 3' direction. This is also true in the 3' → 5' direction.

48. (a) In genetic engineering, the antibiotics are used as a selectable markers.

49. (a) *E. coli* cloning vector pBR322 contains restriction sites (*Hind* III, *Eco*R I, *Bam*H I, *Sal* I, *Pvu* II, *Pst* I, *Cla* I), ori and antibiotic resistance genes (amp^R and tet^R). Rop codes for the proteins involved in the replication of the plasmid.

50. (c) Vector DNA helps to deliver gene of interest into the host.

51. (a) The first letter of the name comes from the genes and the second two letters come from the species of the prokaryotic cell from which they were isolated

In *Eco*RI, the letter 'R' is derived from the name of strain.

52. (a) It is a palindrome sequence (sequence reads the same on two strands).

5'- GAATTC - 3'

3'- CTTAAG - 5'

The palindrome in DNA is a sequence of base pairs that reads same on the two strands when orientation of reading is kept the same.

53. (c) Retrovirus has been disarmed and is now used to deliver desirable genes into animal cells.

54. (d) For the transfer of DNA segment both plasmid and bacteriophage can act as vector.

55. (c) Restriction endonucleases cleaves the DNA into fragments at or near specific recognition sites. These enzyme are found in bacteria and provide a defense mechanism against the DNA of invading viruses.

56. (b) Ti or tumor inducing plasmid is a part of genetic equipment that is used by *Agrobacterium* to transduce their genetic material to plants.

57. (d) Ability of *Agrobacterium* to transfer genes to plants is used in genetic engineering. Ti plasmid of this bacterium is modified and used as cloning vector to transfer gene of interests to plant cells.

58. (a) Plasmids are widely used as cloning vectors. Gene of interest is inserted into these plasmids and then transferred to the hosts for cloning of DNA molecule.

59. (a) Restriction endonuclease cleaves the DNA at a specific site by recognizing palindromic sequences. They make staggered cuts at or near these recognition sites.

60. (d) Two strains of T_4 have different cistrons that codes for different proteins, which together lyse the *E.coli*.

61. (a) Ability of *Agrobacterium tumifaciens* is used to transfer genes to plants & fungi, is used in genetic engineering.

62. (a) Any gene of interest of eukaryotic DNA can be incorporated into these extrachromosomal entities of bacteria called plasmid and then can be cloned inside bacterial cell. Therefore, plasmid is widely used as a cloning vector in recombinant DNA technology.

63. (d) *E.coli* strain is used as the host strain for recombinant protein expression and high levels of synthesis of recombinant human interferons.

64. (b) Nucleases catalyse the cleavage of phosphodiester bonds between nucleotides in nucleic acids. They play crucial role in DNA repair processes.

65. (c) Exonucleases are enzymes that work by cleaving nucleotides one at a time from the end of a polynucleotide chain. It breaks phosphodiester bonds at either 3' or the 5' end.

66. (c) Addition of chilled ethanol precipitates the genomic DNA during the isolation of DNA or genetic material.

67. (b) Main steps in the formation of recombinant DNA in correct sequence are:

B: Cutting of DNA at specific location by restriction enzyme.

C: Isolation of desired DNA fragment by electrophoresis.

D: Amplification of gene of interest using PCR.

A: Insertion of recombinant DNA into the host cell.

68. (a) *Thermus aquaticus*

Thermostable DNA polymerase, crucial for the Polymerase Chain Reaction (PCR) technique, was isolated from *Thermus*

69. (c) Cellulase is used to break down cellulose in plant cell walls, facilitating the isolation of genetic material from plant cells. Chitinase is required to break down chitin, which is a major component of fungal cell walls.

70. (c) DNA fragments are negatively charged molecules that can be separated by forcing them to move towards the anode (positively charged) under an electric field.

71. (d) Gel electrophoresis is a molecular technique used for the separation and analysis of DNA fragments. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. Bright orange coloured bands of DNA can be observed in a ethidium bromide stained gel when exposed to UV light. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.

Selectable markers can differentiate recombinants from non-recombinants due to their capacity to form colour in presence of a chromogenic substance. The presence of a chromogenic substrate gives blue colored colonies if the plasmid in the bacteria does not have an insert.

72. (c) PCR stands for Polymerase Chain Reaction. PCR is a laboratory technique for rapidly producing (amplifying) millions to billions of copies of a specific segment of DNA.

Selectable marker helps in identifying and eliminating non-transformants and selectively permitting the growth of the transformants. The genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or kanamycin, etc., are considered useful selectable markers.

73. (a) In order to isolate the genetic material, i.e., DNA, certain enzymes are used to treat the cells such as lysozyme, cellulose, chitinase, etc. The RNA is removed by ribonuclease. Proteins are removed by protease. The purified DNA is finally precipitated out by addition of chilled ethanol. This can be seen as collection of fine threads in the suspension.

74. (b) Polymerase chain reaction (PCR) involves 3 steps: denaturation, annealing and elongation. The denaturation process requires high temperature of about 94°C. DNA fragments are joined with the help of DNA ligase enzyme. During annealing, primers bind to the target DNA sequences and initiate polymerisation. This process is performed at 50°-60°C. Addition of nucleotides to the primer, synthesises a new DNA with the help of enzyme DNA polymerase. This step is called elongation which is performed at 48 °-72 °C.

75. (a) The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation.

76. (b) DNA fragments in a mixture can be separated on the basis of their size by a technique known as gel electrophoresis. In this techniques, DNA samples are loaded into wells (indentations) at one end of a gel, and an electric current is applied to pull them through the gel. DNA fragments are negatively charged, so they move towards the positive electrode.

77. (c) In recombinant DNA technology, antibiotics are used as selectable markers. Selectable markers helps in identifying and eliminating nontransformants and selectively permitting

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78. (a) Bioreactor – To produce products, such as proteins, in large quantities

Electrophoresis – A technique employed for the separation of DNA fragments on the basis of their size

PCR (Polymerase chain reaction) – It is used for the amplification of nucleic acids.

ELISA (Enzyme-linked immunosorbent assay) – It is based on the antigen-antibody reaction for the detection of pathogens.

79. (c) During DNA extraction, the ethanol can be gently pushed down into the DNA solution by using a glass rod or wooden spooling stick. The charged DNA molecules move away from the ethanol and can be scooped up and swirled around a glass rod or wooden spooling stick. This is call DNA spooling. DNA spooling can isolate long strands of DNA from a solution.

80. (b) Restriction enzyme digestions are performed by incubating purified DNA molecules with the restriction enzyme, at the optimal conditions for that specific enzyme. Agarose gel electrophoresis is employed to check the progression of a restriction enzyme digestion.

DNA ligase joins the gene of interest and the vector DNA.

Gel electrophoresis is used for isolation and separation of gene of interest.

PCR is used for the amplification of a DNA segment.

81. (d) For the production of enzymes in large quantity bioreactors are required. Large scale production involves use of bioreactors.

82. (b) During the isolation of desired gene, chilled ethanol is used for the precipitation of DNA. This can be seen as collection of fine threads in the suspension.

83. (d) Denaturation of double stranded DNA is followed by annealing of short oligonucleotide chains called primers and then at last the DNA polymerase extends or elongates the newly formed strand and thus amplifies the amount of DNA.

84. (b) The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves.

85. (b) Downstream processing is a series of processes such as separation and purification of products after the biosynthetic stage.

The product is formulated with suitable preservatives. Such formulation undergoes through clinical trials as in case of drugs. Strict quality control testing for each product is also required.

86. (d) The separated DNA fragments can be visualised after staining the DNA with ethidium bromide followed by exposure to UV radiation. Bright orange coloured DNA bands can be seen.

87. (b) The processes include separation and purification, which are collectively referred to as downstream processing. The product has to be formulated with suitable preservatives.

88. (a) A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen). The stirrer facilitates even mixing and oxygen availability throughout the bioreactor. The most commonly used bioreactors are of stirring type.

89. (a) A thermostable DNA polymerase (*Taq* polymerase) is isolated from a bacterium, *Thermus aquaticus*, which remains active during the high temperature induced denaturation of double stranded DNA.

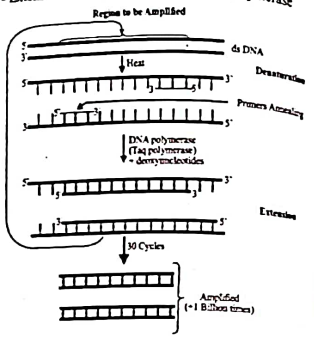
90. (b) In these techniques, segments of DNA that are amplified are random. It creates short primers (8-12 nucleotides)

91. (d) In algae, cell wall is made up of cellulose which degraded by cellulase.

92. (c) A-Denaturation of DNA occurs at a temperature of above 90°C.

B - Annealing or binding of primers

C - Extension in the presence of Taq DNA polymerase



93. (b) Biolistic is used for transformation of plant cells.

94. (a) Repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, *Thermus aquaticus*), which remain active during the high temperature induced denaturation of double stranded DNA.

95. (a) Bolistics or gene gun is a method of introducing alien DNA into host cells of plants. In this, cells are bombarded with high velocity micro - particles of gold or tungsten coated with DNA.

96. (a) Agarose extracted from sea weed is used in gel electrophoresis.

97. (d) Continuous addition of sugars in 'fed batch' fermentation is done to purify enzymes.

98. (c) It facilitates even mixing and oxygen availability throughout the bioreactor.

99. (a) Ligase is the enzyme that links the two ends of DNA by forming a new chemical bond, phosphodiester bond, between 3'-OH at one end of a strand of DNA & 5'-PO_4^{3-} group of another.

100. (b) Plasmids are extrachromosomal double - stranded circular DNA molecules and their size varies from 1 to 200 kbp (kilo base pairs) or sometimes to 500 kbp.

101. (d) Hybridomas are produced by antigen-specific-antibody producing cell's fusion with tumor cells called myeloma cells.

CHAPTER 10

Biotechnology and Its Applications

Biotechnological Application in Agriculture

1. Which of the following statement is incorrect about *Agrobacterium tumifaciens*? *(2023-Manipur)*

a. It is used to deliver gene of interest in both prokaryotic as well as eukaryotic host cells.
b. 'Ti' plasmid from *Agrobacterium tumifaciens* used for gene transfer is not pathogenic to plant cell.
c. It transforms normal plant cells into tumor cells.
d. It delivers 'T-DNA' into plant cell.

2. Transposons can be used during which one of the following? *(2022)*

a. Gene sequencing
b. Polymerase Chain Reaction
c. Gene silencing
d. Autoradiography

3. Bt cotton variety that was developed by the introduction of toxin gene of *Bacillus thuringiensis* (Bt) is resistant to *(2020)*

a. Fungal diseases
b. Plant nematodes
c. Insect predators
d. Insect pests

4. RNA interference is used for which of the following purposes in the field of biotechnology? *(2020-Covid)*

a. To develop a pest resistant plant against infestation by nematode
b. To enhance the mineral usage by the plant
c. To reduce post harvest losses
d. To develop a plant tolerant to abiotic stresses

5. Which of the following is true for Golden rice? *(2019)*

a. It is Vitamin A enriched, with a gene from daffodil
b. It is pest resistant, with a gene from *Bacillus thuringiensis*
c. It is drought tolerant, developed using *Agrobacterium* vector
d. It has yellow grains, because of a gene introduced from a primitive variety of rice

6. What triggers activation of protoxin to active Bt toxin of *Bacillus thuringiensis* in bollworm? *(2019)*

a. Body temperature
b. Moist surface of midgut
c. Alkaline pH of gut
d. Acidic pH of stomach

7. Which part of the tobacco plant is infected by *Meloidogyne incognita*? *(2016 - I)*

a. Flower
b. Leaf
c. Stem
d. Root

8. In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to: *(2015)*

a. Action of gut micro-organism
b. Presence of conversion factors in insect gut
c. Alkaline pH of the insect gut
d. Acidic pH of the insect gut

9. Golden rice is a genetically modified crop plant where the incorporated gene is meant for biosynthesis of: *(2015 Re)*

a. Vitamin C
b. Omega 3
c. Vitamin A
d. Vitamin B

10. Which of the following Bt crops is being grown in India by the farmers? *(2013)*

a. Soyabean
b. Maize
c. Cotton
d. Brinjal

11. Consumption of which one of the following foods can prevent the kind of blindness associated with vitamin 'A' deficiency? *(2012 Mains)*

a. Bt-Brinjal
b. 'Flavr Savr' tomato
c. Canolla
d. Golden rice

12. Tobacco plants resistant to a nematode have been developed by the introduction of DNA that produced (in the host cells): *(2012 Mains)*

a. Both sense and anti-sense RNA
b. A particular hormone
c. An antifeedant
d. A toxic protein

13. *Bacillus thuringiensis* forms protein crystals which contain insecticidal protein. This protein: *(2011 Mains)*

a. Is activated by acid pH of the foregut of the insect pest
b. Does not kill the carrier bacterium which is itself resistant to this toxin
c. Binds with epithelial cells of midgut of the insect pest ultimately killing it
d. Is coded by several genes including the gene cry

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14. Silencing of mRNA has been used in producing transgenic plants resistant to: *(2011 Mains)*
a. White rusts b. Bacterial blights
c. Bollworms d. Nematodes

15. The process of RNA interference has been used in the development of plants resistant to: *(2011 Pre)*
a. Insects b. Nematodes
c. Fungi d. Viruses

16. Some of the characteristics of Bt cotton are: *(2010 Pre)*
a. Medium yield, long fibre and resistance to beetle pests
b. High yield and production of toxic protein crystals which kill dipteran pests
c. High yield and resistance to bollworms
d. Long fibre and resistance to aphids

17. GM brinjal has been developed in India for: *(2010 Pre)*
a. Enhancing shelf life b. Enhancing mineral content
c. Drought resistance d. Insect resistance

18. An improved variety of transgenic basmati rice: *(2010 Pre)*
a. Gives high yield and is rich in vitamin A
b. Is completely resistant to all insect pests and diseases of paddy
c. Gives high yield but has no characteristic aroma
d. Does not require chemical fertilisers and growth hormones

19. What is true of Bt toxin? *(2009)*
a. The concerned *Bacillus* has antitoxins
b. The inactive protoxin gets converted into active form in the insect gut
c. Bt protein exists as active toxin in the *Bacillus*
d. The activated toxin enters the ovaries of the pest to sterilize it and thus prevents its multiplication

20. The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as: *(2009)*
a. Source of industrial enzyme
b. Insecticide
c. Indicator of water pollution
d. Agent for production of dairy products

Main objective of production of herbicide resistant GM crops is to: *(2008)*
a. Encourage ecofriendly herbicides
b. Reduce herbicide accumulation in food articles for health safety
c. Eliminate weeds from fields without the use of manual labour
d. Eliminate weeds from field without the use of herbicides

Golden rice will help in: *(2006)*
a. Producing petrol-like fuel
b. Pest resistance
c. Herbicide tolerance
d. Alleviation of vitamin A deficiency

23. The most thoroughly studied of the known bacteria-plant interactions is the: [OS] *(2014)*
a. Gall formation on certain angiosperms by *Agrobacterium*
b. Modulation of *Sesbania* stems by nitrogen fixing bacteria
c. Plant growth stimulation by phosphate- solubilizing bacteria
d. Cyanobacterial symbiosis with some aquatic ferns

24. Introduction of food plants developed by genetic engineering is not desirable because: *(2013)*
a. Economy of developing countries may suffer.
b. These products are less tasty as compared to the already existing products.
c. This method is costly.
d. There is danger of coming viruses, allergens and toxins with introduced crop.

Biotechnological Application in Medicine

25. Which one of the following techniques does not serve the purpose of early diagnosis of a disease for its early treatment? [MR*] *(2023)*
a. Enzyme Linked Immuno-Sorbent Assay (ELISA) technique
b. Recombinant DNA Technology
c. Serum and Urine analysis
d. Polymerase Chain Reaction (PCR) technique

26. Select **Incorrect** statement, regarding chemical structure of insulin. *(2023-Manipur)*
a. Mature insulin molecule consists of three polypeptide chains-A, B and C.
b. Insulin is synthesized as prohormone which contains extra stretch of C-peptide.
c. C-peptide is not present in mature insulin molecule.
d. Polypeptide chains A and B are linked by disulphide bridges.

27. Match **List-I** with **List-II**. [MR*] *(2023-Manipur)*

List-I		List-II	
(A)	Gene therapy	(I)	Separation of DNA fragments
(B)	RNA interference	(II)	Diagnostic test for AIDS
(C)	ELISA	(III)	Cellular defence
(D)	Gel Electrophoresis	(IV)	Allows correction of a gene defect

Choose the **correct** answer from the options given below:
a. (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
b. (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
c. (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
d. (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

28. Match **List-I** with **List-II**: [MR*] *(2022)*

List-I		List-II	
(A)	Gene gun	(I)	Replacement of a faulty gene by a normal healthy gene
(B)	Gene therapy	(II)	Used for transfer of Gene
(C)	Gene cloning	(III)	Total DNA in the cells of an organism
(D)	Genome	(IV)	To obtain identical copies of a particular DNA molecule

Choose the correct answer from the options given below:
a. A-II, B-III, C-IV, D-I
b. A-II, B-I, C-IV, D-III
c. A-I, B-III, C-II, D-IV
d. A-IV, B-I, C-III, D-II

29. In gene therapy of Adenosine Deaminase (ADA) deficiency, the patient requires periodic infusion genetically engineered lymphocytes because: *(2022)*
a. Genetically engineered lymphocytes are not immortal cells.
b. Retroviral vector is introduced into these lymphocytes.
c. Gene isolated from marrow cells producing ADA is introduced into cells at embryonic stages
d. Lymphocytes from patient's blood are grown in culture, outside the body.

30. Statements related to human Insulin are given below. Which statement(s) is/are correct about genetically engineered Insulin? *(2022)*
A. Pro-hormone insulin contain extra stretch of C-peptide
B. A-peptide and B-peptide chains of insulin were produced separately in *E.coli*, extracted and combined by creating disulphide bond between them.
C. Insulin used for treating Diabetes was extracted from Cattles and Pigs.
D. Pro-hormone Insulin needs to be processed for converting into a mature and functional hormone.
E. Some patients develop allergic reactions to the foreign insulin.
Choose the most appropriate answer from the options given below.
a. C, D and E only b. A, B and D only
c. B only d. C and D only

31. When gene targeting involving gene amplification is attempted in an individual's tissue to treat disease, it is known as: *(2021)*
a. Gene therapy b. Molecular diagnosis
c. Safety testing d. Biopiracy

32. Which of the following is not an application of PCR (Polymerase Chain Reaction) ? *(2021)*
a. Gene amplification
b. Purification of isolated protein
c. Detection of gene mutation
d. Molecular diagnosis

33. Which of the following is a correct sequence of steps in a PCR (Polymerase Chain Reaction)? *(2021)*
a. Denaturation, Extension, Annealing
b. Extension, Denaturation, Annealing
c. Annealing, Denaturation, Extension
d. Denaturation, Annealing, Extension

34. Now a days it is possible to detect the mutated gene causing cancer by allowing radioactive probe to hybridise its complementary DNA in a clone of cells, followed by its detection using autoradiography because: *(2021)*
a. Mutated gene completely and clearly appears on a photographic film.
b. Mutated gene does not appear on a photographic film as the prober has no complementarity with it.
c. Mutated gene does not appear on photographic film as the probe has complementarity with it.
d. Mutated gene partially appears on a photographic film.

35. With regard to insulin choose correct options. *(2021)*
A. C-peptide is not present in mature insulin.
B. The insulin produced by rDNA technology has C-peptide.
C. The pro-insulin has C-peptide.
D. A-peptide and B-peptide of insulin are interconnected by disulphide bridges.
Choose the correct answer from the options given below.
a. B and C only b. A, C and D only
c. A and D only d. B and D only

36. For effective treatment of the disease, early diagnosis and understanding its pathophysiology is very important. Which of the following molecular diagnostic techniques is very useful for early detection? *(2021)*
a. Southern Blotting Technique
b. ELISA Technique
c. Hybridization Technique
d. Western Blotting Technique

37. The adenosine deaminase deficiency results into: *(2021)*
a. Parkinson's disease
b. Digestive disorder
c. Addison's disease
d. Dysfunction of Immune system

38. Which of the following statements is not correct? *(2020)*
a. The proinsulin has an extra peptide called C-peptide
b. The functional insulin has A and B chains linked together by hydrogen bonds
c. Genetically engineered insulin is produced in *E.coli*.
d. In man insulin is synthesised as a proinsulin.

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39. Match the following columns and select the correct option [MR*] *(2020)*

	Column - I		Column - II
1.	Bt cotton	(i)	Gene therapy
2.	Adenosine deaminase deficiency	(ii)	Cellular defence
3.	RNAi	(iii)	Detection of HIV infection
4.	PCR	(iv)	*Bacillus thuringiensis*

	(1)	(2)	(3)	(4)
a.	(iii)	(ii)	(i)	(iv)
b.	(ii)	(iii)	(iv)	(i)
c.	(i)	(ii)	(iii)	(iv)
d.	(iv)	(i)	(ii)	(iii)

40. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes? *(2018)*
a. Retrovirus b. Ti plasmid
c. λ phage d. pBR322

41. Which kind of therapy was given in *1990* to a four year old girl with adenosine deaminase (ADA) deficiency? *(2016 - II)*
a. Immunotherapy b. Radiation therapy
c. Gene therapy d. Chemotherapy

42. The two polypeptides of human insulin are linked together by: *(2016 - I)*
a. Hydrogen bonds b. Phosphodiester bond
c. Covalent bond d. Disulphide bridges

43. ADA is an enzyme which is deficient in a genetic disorder SCID. What is the full form of ADA? *(2014)*
a. Adenosine DeoxyAminase
b. Adenosine Deaminase
c. Aspartate Deaminase
d. Arginine Deaminase

44. The first human hormone produced by recombinant DNA technology is: *(2014)*
a. Progesterone b. Insulin
c. Estrogen d. Thyroxin

45. The first clinical gene therapy was given for treating *(2012 Mains)*
a. Diabetes mellitus
b. Chicken pox
c. Rheumatoid arthritis
d. Adenosine deaminase deficiency

46. A single strand of nucleic acid tagged with a radioactive molecule is called: *(2012 Pre)*
a. Probe b. Vector
c. Selectable marker d. Plasmid

47. Read the following four statements (A-D) about certain mistakes in two of them
A. The first transgenic buffalo Rosie produced milk which was human alpha-lactalbumin enriched
B. Restriction enzymes are used in isolation of DNA from other macromolecules
C. Downstream processing is one of the steps of R-DNA technology
D. Disarmed pathogen vectors are also used in transfer of R-DNA into the host
Which are the two statements having mistakes? *(2011 Mains)*
a. Statements (A) and (C) b. Statements (A) and (B)
c. Statements (B) and (C) d. Statements (C) and (D)

48. DNA or RNA segment tagged with a radioactive molecule is called: *(2010 Pre)*
a. Probe b. Clone
c. Plasmid d. Vector

49. The genetic defect adenosine deaminase (ADA) deficiency may be cured permanently by: *(2009)*
a. Introducing bone marrow cells producing (ADA) into cells at early embryonic stages
b. Administrating adenosine deaminase activators
c. Periodic infusion of genetically engineered lymphocytes having functional ADA cDNA
d. Enzyme replacement therapy

50. Which is used in production of insulin by genetic engineering? *(2008)*
a. *Rhizobium* b. *Saccharomyces*
c. *Mycobacterium* d. *Escherichia*

51. Genetically engineered microorganism used successfully in bioremediation of oil spills is: *(2007)*
a. *Trichoderma* b. *Xanthomonas*
c. *Bacillus* d. *Pseudomonas*

52. ELISA is used to detect viruses, where: *(2004)*
a. Southern blotting is done
b. Alkaline phosphatase is the key reagent
c. Catalase is the key reagent
d. DNA-probes are required

53. ELISA is used to detect viruses where the key reagent is: *(2003)*
a. Alkaline phosphatase b. Catalase
c. DNA probe d. RNase

Transgenic Animals

54. Milk of transgenic 'Cow Rosie' was nutritionally more balanced product for human babies than natural cow milk because it contained: *(2022 Re)*
a. Human enzyme Adenosine Deaminase (ADA)
b. Human protein α-1-antitrypsin
c. Human alpha-lactalbumin
d. Human insulin-like growth factor

55. Genetic engineering has been successfully used for producing: *(2010 Pre)*
a. Transgenic models for studying new treatments for certain cardiac disease
b. Transgenic cow, Rosie, which produces high fat milk for making ghee
c. Animals like bulls for farm work as they have super power
d. Transgenic mice for testing safety of polio vaccine before use in humans

56. Transgenic plants are the ones: *(2009)*
a. Grown on artificial medium after hybridisation in the field
b. Produced after protoplast fusion in artificial medium
c. Produced by somatic embryo on artificial medium
d. Generated by introducing foreign DNA into a cell and regenerating plant from that cell

57. In transgenics expression of transgene in targets tissue is determined by: *(2004)*
a. Transgene b. Promoter
c. Reporter d. Enhancer

58. First cloned animal: [OS]*(2000)*
a. Dolly sheep b. Polly sheep
c. Molly sheep d. Dog

59. A giant rat is formed in the laboratory, what is the reason? *(2000)*
a. Gene mutation b. Gene synthesis
c. Gene manipulation d. Gene replication

60. First transgenic plant: [OS]*(1999)*
a. Potato b. Tomato
c. Tobacco d. Maize

61. The transgenic animals are those which have: *(1995)*
a. Foreign RNA in all its cells
b. Foreign DNA in some of its cells
c. Foreign DNA in all its cells
d. Both (a) and (b)

Ethical Issues

62. The laws and rules to prevent unauthorised exploitation of bio-resources are termed as- *(2020-Covid)*
a. Bioethics b. Bioengineering
c. Biopiracy d. Biopatenting

63. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is: *(2018)*
a. Indian Council of Medical Research (ICMR)
b. Council for Scientific and Industrial Research (CSIR)
c. Research Committee on Genetic Manipulation (RCGM)
d. Genetic Engineering Appraisal Committee (GEAC)

64. A 'new' variety of rice was patented by a foreign company though such varieties have been present in India for a long time. This is related to: *(2018)*
a. Co-667 b. Sharbati Sonora
c. Lerma Rojo d. Basmati

65. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called: *(2018)*
a. Bio-infringement
b. Biopiracy
c. Biodegradation
d. Bioexploitation

66. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services? *(2015)*
a. Genetic Engineering Approval Committee
b. Research Committee on Genetic Manipulation
c. Bio-safety committee
d. Indian Council of Agricultural Research

Answer Key

1. (a)	2. (c)	3. (d)	4. (a)	5. (a)	6. (c)	7. (d)	8. (c)	9. (c)	10. (c)
11. (d)	12. (a)	13. (c)	14. (d)	15. (b)	16. (b)	17. (d)	18. (a)	19. (b)	20. (b)
21. (b)	22. (d)	23. (a)	24. (d)	25. (c)	26. (a)	27. (c)	28. (b)	29. (a)	30. (c)
31. (a)	32. (b)	33. (d)	34. (b)	35. (b)	36. (b)	37. (d)	38. (b)	39. (d)	40. (a)
41. (c)	42. (d)	43. (b)	44. (b)	45. (d)	46. (a)	47. (b)	48. (a)	49. (a)	50. (d)
51. (d)	52. (b)	53. (a)	54. (c)	55. (d)	56. (d)	57. (b)	58. (a)	59. (c)	60. (c)
61. (c)	62. (d)	63. (d)	64. (d)	65. (b)	66. (a)				

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Explanations

1. **(a)** *Agrobacterium tumefaciens* is a pathogen of several dicot plants that is able to deliver a piece of DNA known as 'T-DNA' to transform normal plant cells into a tumour and direct these tumour cells to produce the chemicals required by the pathogen. It is primarily used in plant cells (eukaryotes) and not in prokaryotic cells.

2. **(c)** Transposons are segments of DNA that can move around to different positions in the genome of a single cell. During mRNA silencing, the source of complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.

3. **(d)** *B. thuringiensis* forms protein crystals which contain a toxic insecticidal protein. The toxin is coded by a gene named cry. The proteins encoded by the genes *cryIAc* and *cryIIAb* control the cotton bollworms, that of *cryIAb* controls corn borer.

4. **(a)** A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield. RNA interference is used to prevent this infestation. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).

5. **(a)** Golden rice is vitamin A enriched rice, with a gene from daffodil. It is also rich in carotene.

6. **(c)** *Bacillus thuringiensis* produce protein crystals during a particular phase of their growth. These crystals contain a toxic insecticidal protein. These protein exist as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to alkaline pH of the gut which solubilize the crystals. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually cause death of insect.

7. **(d)** A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield.

8. **(c)** The Bt toxin protein exists as inactive protoxins but once ingested by insect, it is converted into an active form of toxin due to alkaline pH of the gut which solubilise the crystal. The activated toxin binds to the surface of midgut epithelial cells and creates pores, causes insect death.

9. **(c)** Genetic modification enhanced nutritional value of food. e.g., Vitamin 'A' enriched rice

10. **(c)** Bt - cotton is grown in India.

11. **(d)** Golden rice is a best source of Vitamin A and can prevent the kind of blindness (Night Blindness).

12. **(a)** Tobacco plants resistance to a nematode has been developed by the introduction of DNA, produce sense and anti-sense RNA in host cells.

13. **(c)** The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis and eventually cause death of the insect.

14. **(d)** Silencing of mRNA has been used in producing transgenic plants resistant to nematodes (*Meloidegyne incognitia*), a nematode *Meloidegyne incognitia* infects the root of tobacco plants and causes a great reduction in yield. Strategy based on RNA interference (RNAi) prevents this infestation.

15. **(b)** RNAi has also been exploited in plants to develop resistance against nematodes and this approach has appeared as a novel tool to control plant parasitic nematodes.

16. **(b)** High yield and production of toxin by cryIAc and cryIIAb to control cotton bollworm.

17. **(d)** Bt. brinjal has been developed in India is resistance a insect.

18. **(a)** Golden rice is the result of biotechnology with the help of which we are able to enhance the nutritional value of food eg: Vitamin 'A' enriched rice.

19. **(b)** Bt. toxin is inactive toxin secreted by bacteria *Bacillus thuringiensis*. It requires alkaline medium to get active which is possible in insect gut.

20. **(b)** *Bacillus thuringiensis* is an insecticide. It is effective against lepidopterans, coleopterans and dipterans.

21. **(b)** Productions of herbicide resistant GM crops are the towards to reduce reliance on chemical pesticides.

22. **(d)** Golden rice is the result of biotechnology with the help of which we are able to enhance the nutritional value of food E.g. Vitamin 'A' enriched rice.

23. **(a)** *Agrobacterium tumefaciens*, rod - shaped, Gram - negative soil bacterium, is the causal agent of crown gall disease in over 140 species of eudicots. This is a unique disease involving the transfer of DNA from the bacterium to the nucleus of plant cells.

24. **(d)** By using genetic engineering, several crop plants are made transgenic. Desired genes are introduced in the genome of plants to make them transgenic but sometimes it may lead production of undesired products such as allergens and toxins which are harmful to consumers.

25. **(c)** Of these, serum and urine analysis does not fulfil the purpose of early diagnosis of a disease. In early stages of infections, when the disease symptoms are not visible, amplification of pathogenic nucleic acid can be done by PCR, detection of antibodies produced by host against pathogen by ELISA and rDNA technology can serve the purpose of early diagnosis.

26. **(a)** The mature insulin molecule consists of two polypeptide chains (A and B), not three. Insulin is initially synthesised as a prohormone, including an A, B, and C-peptide.

27. **(c)** A- IV, B- III, C- II, D- I

(A) Gene therapy - (IV) Allows correction of a gene defect

(B) RNA interference - (III) Cellular defence

(C) ELISA - (II) Diagnostic test for AIDS

(D) Gel Electrophoresis - (I) Separation of DNA fragments

28. **(b)**

A. Gene gun - (II) Used for transfer of Gene

B. Gene therapy - (I) Replacement of a faulty gene by a normal healthy gene

C. Gene cloning - (IV) To obtain identical copies of a particular DNA molecule

D. Genome - (III) Total DNA in the cells of an organism

29. **(a)** In gene therapy of Adenosine Deaminase (ADA) deficiency, lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient. The patient requires periodic infusion of genetically engineered lymphocytes because these cells are not immortal.

30. **(c)** Statement B is correct about genetically engineered Insulin. Rest all statements describe about structure and problems associated with artificial Insulin.

31. **(a)** Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/ embryo.

Molecular diagnosis is a process through which the nature and cause of diseases can be detected at earlier stage. This can be done by different methods such as PCR, ELISA, autoradiography, etc.

Safety testing is a process through which the toxicity of drugs is checked.

Biopiracy refers to use of the bio- resources without getting it authorised by the concerned authority.

32. **(b)** Some of the applications of PCR are:

- Detection of HIV and genetic disorders
- Gene amplification
- Detection of mutation in genes in cancer patients

Therefore, purification of isolated protein is not an application of PCR.

33. **(d)** The PCR (polymerase chain reaction) occurs in three steps namely;

- Denaturation of DNA fragments
- Annealing
- Extension of the primers

34. **(b)** A single stranded DNA or RNA, tagged with a radioactive molecule (probe) is allowed to hybridize to its complementary DNA in a clone of cells followed by detection using autoradiography. The clone having the mutated gene will hence not appear on the photographic film, because the probe will not have complementarity with the mutated gene.

35. **(b)** Insulin consists of two short polypeptide chains: chain A and chain B, that are linked together by disulphide bridges. As a pro-hormone, insulin has A chain, B chain and an extra stretch called C-peptide. C-peptide is not present in mature insulin called humulin. Hence statement (b) is incorrect.

36. **(b)** ELISA can be used for early detection of an infection either by detecting the presence of pathogenic antigen (proteins, glycoproteins, etc.,) or by detecting the antibodies synthesized against the pathogen.

37. **(d)** Adenosine deaminase (ADA) enzyme is crucial for the immune system to function. Hence, its deficiency results in the dysfunction of immune system.

Addison's disease is caused due to hyposecretion of hormones of the adrenal cortex.

Parkinson's disease is a disorder of the central nervous system that affects movement.

A digestive disorder is any disorder that occurs in the digestive tract and affects gastrointestinal tract & associated glands.

38. **(b)** The functional insulin has A and B chains linked together by disulphide bonds.

39. **(d)** Bt cotton - the specific Bt toxin gene was isolated from *Bacillus thuringiensis*

Adenosine deaminase (ADA) deficiency – Gene therapy was employed for its treatment

RNAi (RNA interference)- Takes place in all eukaryotic organisms as a method of cellular defense

PCR – Used for the detection of HIV infection

40. **(a)** Retroviral vectors are especially appropriate for the transduction mediated by non-immunogenic vectors.

41. **(c)** Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/ embryo.

The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency. This enzyme is crucial for the immune system to function.

42. **(d)** The two polypeptides of human insulin are linked together by disulphide bridges.

43. **(b)** ADA is an enzyme which is deficient in a genetic disorder SCID. ADA stands for adenosine deaminase. This enzyme is crucial for the immune system to function.

44. **(b)** Insulin was the first human hormone produced by rDNA technology.

45. **(d)** First clinical gene therapy was given in 1990 to 4 year old gene with (ADA) deficiency; caused by deletion of gene.

46. **(a)** A single strand of nucleic acid tagged with a radioactive molecule is called probe. Currently, many different probes are used to generate DNA fingerprints.

47. **(b)** Statement A: In 1997, the first transgenic cow, Rosie, produced human protein-enriched milk (2.4 grams per litre). The milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk.

Statement B: Restriction enzymes bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar -phosphate backbones.

48. **(a)** A single stranded DNA or RNA, tagged with a radioactive molecule is called probe.

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49. (a) ADA cannot have permanent cure because lymphocytes transfused are not immortal. But if bone marrow cells producing ADA introduced at an early embryonic stage. It will be permanent cure.

50. (d) Insulin consists of two polypeptide chains A and B. Two DNA sequences corresponding to "A and B" is introduced in the plasmids of *E. coli* to produce insulin with the help of rDNA technology.

51. (d) *Pseudomonas putida* is genetically modified organisms used successfully in bioremediation of oil spill.

52. (b) ELISA (Enzyme Linked Immunosorbent Assay) is a technique that uses antibody - antigen reaction and identify the substance by detecting the colour changes. Alkaline phosphatase and Horse radish peroxidase is used in this technique as key reagent.

53. (a) Alkaline phosphatase is used as key reagent to detect viruses through the technique Enzyme Linked Immunosorbent Assay.

54. (c) Human alpha-lactalbumin

The milk of transgenic 'Cow Rosie' was made nutritionally more balanced for human babies by incorporating human alpha-lactalbumin, enhancing the nutritional quality of the milk.

55. (d) 95% of transgenic animals are mice.

56. (d) Transgenic plants are obtained by genetic engineering. There genes have been altered by manipulation.

57. (b) Specificity of a promoter is crucial in controlling expression of transgene. A promoter is a region of DNA that initiates transcription of a particular gene.

58. (a) Dolly was the first mammal cloned from an adult somatic cell, using the process of nuclear transfer in the Roslin Institute.

59. (c) Genetic manipulation (or genetic engineering) is manipulation of the genes of an organism using biotechnology that can result in major changes in the organism.

60. (c) First genetically modified plant was produced in 1982. It was an antibiotic resistant tobacco plant.

61. (c) Transgenic animals have a foreign gene inserted into their entire genome, i.e., in gene of all cells.

62. (d) Biopiracy is the term used to refer to the use of bio-resources by multinational companies and other organisations without proper authorisation from the countries and people concerned without compensatory payment. The laws and rules to prevent unauthorised exploitation of bioresources are termed as biopatents.

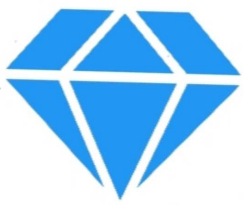
63. (d) Genetic Engineering Approval Committee (GEAC) is responsible for approval of proposals relating to release of genetically engineered organisms.

64. (d) Basmati rice biopatented by an US company against which India has just begin the battle against biopiracy.

65. (b) Biopiracy describes a practice in which naturally occurring material and indigenous knowledge is used by researchers or companies without permission of indigenous people. It is an unethical commercial exploitation of biological materials.

66. (a) The Indian government has set up organisations such as GEAC (Genetic Engineering approval Committee), which will make decisions regarding the validity of GM research and safety of introducing (GMO) for public services.

TEAM Kohinoor



CHAPTER 11

Organisms and Populations

Major Biomes, Abiotic Factors and Responses to Abiotic Factors

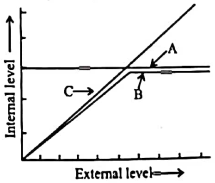
1. Niche is: *(2018)*
   a. All the biological factors in the organism environment
   b. The physical space where an organism live
   c. The range of temperature that the organism needs to live
   d. The functional role played by the organism where it lives

2. Most animals are tree dwellers in a: [OS]*(2015)*
   a. Temperature deciduous forest
   b. Tropical rain forest
   c. Coniferous forest
   d. Thorn woodland

3. Just as a person moving from Delhi to Shimla to escape the heat for the duration of hot summer, thousands of migratory birds from Siberia and other extremely cold northern regions move to: [OS]*(2014)*
   a. Keolado National Park
   b. Western Ghat
   c. Meghalaya
   d. Corbett National Park

4. Large Woody Vines are more commonly found in: [OS]*(2011 Pre)*
   a. Alpine forests b. Temperate forests
   c. Mangroves d. Tropical rainforests

5. The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do (A), (B), (C) represent respectively? *(2010 Pre)*



	A	B	C
a.	Regulator	Partial regulator	Conformer
b.	Partial regulator	Regulator	Conformer
c.	Regulator	Conformer	Partial regulator
d.	Conformer	Regulator	Partial regulator

6. At which latitude heat gain through insulation approximately equals heat loss through terrestrial radiation? [OS]*(2005)*
   a. 22.5° North and South
   b. 40° North and South
   c. 42.5° North and South
   d. 66° North and South

7. In which one of the following habitats does the diurnal temperature of soil surface vary most? [OS]*(2004)*
   a. Forest b. Desert
   c. Grassland d. Shrub land

8. In which one of the following pairs is the specific characteristic of a soil not correctly matched? [OS]*(2004)*
   a. Terra rossa - Most suitable for roses
   b. Chernozems - Richest soil in the world
   c. Black soil - Rich in calcium carbonate
   d. Laterite - Contains aluminium compound

9. Which statement is correct about centre of origin of plant? [OS]*(2001)*
   a. More diversity in improved variety
   b. Frequency of dominant gene is more
   c. Climatic condition more favourable
   d. None

10. What is the best pH of the soil for cultivation of plants? [OS]*(2001)*
    a. 3.4 – 5.4 b. 6.5 – 7.5
    c. 4.5 – 8.5 d. 5.5 – 6.5

11. Biotic and abiotic components form: *(1999)*
    a. Community b. Society
    c. Population d. Species

12. *Acacia, Prosopis* and *Capparis* belongs to: [OS]*(1998)*
    a. Deciduous forest b. Tropical forest
    c. Thorn forest d. Evergreen forest

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13. The 'niche' of a species is meant for: *(1996)*
a. Habitat and specific function of a species
b. Specific place where an organism lives
c. Specific species function and its competitive power
d. None of these

14. Benthic animals are those which: **[OS]***(1996)*
a. Are submerged in area b. Float on the sea surface
c. Are deep dweller in sea d. Are floating (free) organisms

15. Study of inter-relationships between organisms and their environment is: *(1993)*
a. Ecology b. Ecosystem
c. Phytogeography d. Ethology

16. The sum total of the populations of the same kind of organisms constitute: *(1993)*
a. Colony b. Genus
c. Community d. Species

17. Fertility of soil is measured by its ability to: **[OS]***(1992)*
a. Retain nutrients b. Hold organic materials
c. Hold water d. Support life

18. Soil particles determine its: **[OS]***(1992)*
a. Texture b. Field capacity
c. Water holding capacity d. Soil flora

19. Deep black soil is productive due to high proportion of: **[OS]***(1991)*
a. Sand and zinc b. Gravel and calcium
c. Clay and humus d. Silt and earthworm

20. Homeostasis is: *(1991)*
a. Tendency of biological systems to change with change in environment
b. Tendency of biological systems to resist change
c. Disturbance of self regulatory system and natural controls
d. Biotic materials used in homeopathic medicines

Adaptations

21. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**. *(2023-Manipur)*
Assertion (A): A person goes to high altitude and experiences "Altitude Sickness" with symptoms like breathing difficulty and heart palpitations.
Reason (R): Due to low atmospheric pressure at high altitude, the body does not get sufficient oxygen.
In the light of the above statements, choose the **correct** answer from the options given below:
a. **(A)** is true but **(R)** is false
b. **(A)** is false but **(R)** is true
c. Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
d. Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.

22. Match List-I with List-II:

	List-I		List-II
(A)	Allen's Rule	(i)	Kangaroo rat
(B)	Physiological adaptation	(ii)	Desert lizard
(C)	Behavioural adaptation	(iii)	Marine fish at depth
(D)	Biochemical adaptation	(iv)	Polar seal

Choose the correct answer from the options given below: **[MR*]** *(2021)*
a. A-iv B-i C-iii D-ii
b. A-iv B-i C-ii D-iii
c. A-iv B-iii C-ii D-i
d. A-iv B-ii C-iii D-i

23. **Assertion (A):** A person goes to high altitude and experiences 'altitude sickness' with symptoms like breathing difficulty and heart palpitations.
Reason (R): Due to low atmospheric pressure at high altitude, the body does not get sufficient oxygen.
In the light of the above statements, choose the correct answer from the options given below: *(2021)*
a. Both (A) and (R) are true but (R) is not the correct explanation of (A)
b. (A) is true but (R) is false
c. (A) is false but (R) is true
d. Both (A) and (R) are true and (R) is the correct explanation of (A)

24. Plants which produce characteristic pneumatophores and show vivipary belong to: **[OS]***(2017-Delhi)*
a. Mesophytes b. Halophytes
c. Psammophytes d. Hydrophytes

25. It is much easier for a small animal to run uphill than for a large animal, because: *(2016 - I)*
a. It is easier to carry a small body weight
b. Smaller animals have a higher metabolic rate
c. Smaller animals have a lower O_2 requirement
d. The efficiency of muscles in large animals is less than in the small animals

26. Which of the following are likely to be present in deep sea water? *(2014)*
a. Saprophytic fungi b. Archaebacteria
c. Eubacteria d. Blue-green algae

27. People who have migrated from the planes to an area adjoining Rohtang Pass about six months back: *(2012 Pre)*
a. Have the usual RBC count but their haemoglobin has very high binding affinity of O_2
b. Have more RBCs and their haemoglobin has a lower binding affinity of O_2
c. Are not physically fit to play games like football
d. Suffer from altitude sickness with symptoms like nausea, fatigue, etc

28. Consider the following four conditions (A - D) and select the correct pair of them as adaptation to environment in desert lizards. The conditions: *(2011 Pre)*
A. Burrowing in soil to escape high temperature
B. Losing heat rapidly from the body during high temperature
C. Bask in sun when temperature is low
D. Insulating body due to thick fatty dermis
a. (A), (B) b. (C), (D)
c. (A), (C) d. (B), (D)

29. Which two of the following changes (A-D) usually tend to occur in plain dwellers when they move to higher altitudes (3500 m or more)? *(2010 Pre)*
A. Increase in red blood cell size
B. Increase in red blood cell production
C. Increase in breathing rate
D. Increase in thrombocytes count
a. C and D b. A and D
c. A and B d. B and C

30. Which of the following is a xerophytic plant in which the stem is modified into a flat green and succulent structure? *(2010 Pre)*
a. *Casuarina* b. *Opuntia*
c. *Hydrilla* d. *Acacia*

31. Reduction in vascular tissue, mechanical tissue and cuticle are characteristic of: *(2009)*
a. Mesophytes b. Hydrophytes
c. Xerophytes d. Epiphytes

32. Which are true about the following statements about kangaroo rats? *(2008)*
A. They have dark color, high rate of reproduction and excrete solid urine
B. They do not drink water, breathe at slow rate, and have their body covered with thick hair
C. The feed on dry seeds and do not required drinking water
D. They excrete very concentrated urine and do not used water to regulate body temperature
a. A and B b. C and D
c. B and C d. C and A

33. People living at sea level have around 5 million RBCs/mm³ of blood whereas those living at an altitude of 5400 m have around 8 million. This is due to: *(2006)*
a. There is more UV radiation which enhances RBCs production
b. People eat more nutritive food which helps in formation of more RBCs
c. People get pollution free air to breathe with more oxygen becoming available
d. Atmospheric O_2 level is less so that more RBCs are needed to absorb the required amount of O_2 to survive

34. Significance of mimicry is: **[OS]***(2002)*
a. Attack (Offence) b. Protection (Defence)
c. Both (a) & (b) d. Isolation

35. In which of the following plant sunken stomata are found? *(2001)*
a. *Nerium* b. *Hydrilla*
c. Mango d. Guava

36. Most animals of desert are: **[OS]***(1998)*
a. Arboreal b. Fossorial
c. Crepuscular d. Nocturnal

37. During adverse season, therophytes survive by: **[OS]***(1997)*
a. Rhizomes b. Seeds
c. Bulbs d. Corms

38. The animals of cold countries have relatively shorter and poorly developed ears, eyes, hairs and other phenotypic characters. This is known by which law? *(1996)*
a. Cope's Law b. Dollo's Law
c. Allen's Law d. Bergmann's Law

39. At high altitude, the RBCs in the human blood will: *(1995)*
a. Increase in number b. Decrease in number
c. Increase in size d. Decrease in size

Population Attributes, Population Growth and Life History Variation

40. Match List-I with List-II. **[MR*]** *(2023)*

	List-I		List-II
(A)	Logistic growth	(I)	Unlimited resource availability condition
(B)	Exponential growth	(II)	Limited resource availability condition
(C)	Expanding age pyramid	(III)	The percent individuals of pre-reproductive age is largest followed by reproductive and post reproductive age groups
(D)	Stable age pyramid	(IV)	The percent individuals of pre-reproductives and reproductive age group are same

Choose the correct answer from the options given below:
a. A-II, B-IV, C-III, D-I b. A-II, B-I, C-III, D-IV
c. A-II, B-III, C-I, D-IV d. A-II, B-IV, C-I, D-III

41. If there are 250 snails in a pond, and within a year their number increases to 2500 by reproduction. *(2023-Manipur)*
What should be their birth rate per snail per year?
a. 10 b. 9
c. 25 d. 15

42. If '8' *Drosophila* in a laboratory population of '80' died during a week, the death rate in the population is _____ individuals per *Drosophila* per week. *(2022)*
a. Zero b. 0.1
c. 10 d. 1.0

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43. In the exponential growth equation $N_t = N_0 e^{rt}$, e represents: *(2021)*
a. The base of exponential logarithms
b. The base of natural logarithms
c. The base of geometric logarithms
d. The base of number logarithms

44. Which of the following is not an attribute of a population? *(2020)*
a. Natality b. Mortality
c. Species interaction d. Sex ratio

45. The impact of immigration on population density is: *(2020-Covid)*
a. Both positive and negative
b. Neutralized by natality
c. Positive
d. Negative

46. Natality refers to: *(2018)*
a. Death rate
b. Birth rate
c. Number of individuals leaving the habitat
d. Number of individuals entering a habitat

47. In a growing population of a country: *(2018)*
a. Pre-reproductive individuals are more than the reproductive individuals.
b. Reproductive individuals are less than the post-reproductive individuals.
c. Reproductive and pre-reproductive individuals are equal in number.
d. Pre-reproductive individuals are less than the reproductive individuals.

48. Asymptote in a logistic growth curve is obtained when: *(2017-Delhi)*
a. The value of 'r' approaches zero
b. K = N
c. K > N
d. K < N

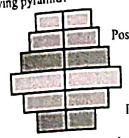
49. When does the growth rate of a population following the logistic model equal zero? The logistic model is given as $dN/dt = rN(1-N/K)$: *(2016 - I)*
a. When N/K is exactly one
b. When N nears the carrying capacity of the habitat
c. When N/K equals zero
d. When death rate is greater than birth rate

50. Which of the following is correct for r-selected species? *(2016 - II)*
a. Small number of progeny with small size
b. Small number of progeny with large size
c. Large number of progeny with small size
d. Large number of progeny with large size

51. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is: *(2013)*
a. Zero b. 10
c. 15 d. 05

52. The logistic population growth is expressed by the equation: *(2011 Pre)*
a. $dN/dt = rN$ b. $dN/dt = rN\left(\frac{N-K}{N}\right)$
c. $dt/dN = Nr\left(\frac{K-N}{K}\right)$ d. $dN/dt = rN\left(\frac{K-N}{K}\right)$

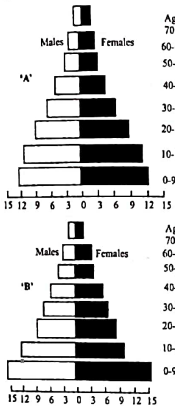
53. What type of human population is represented by the following pyramid? *(2011 Pre)*



a. Expanding population b. Vanishing population
c. Stable population d. Declining population

54. Which one of the following is a characteristic of biological community? *(2010 Pre)*
a. Natality b. Mortality
c. Sex ratio d. Stratification

55. A country with high rate of population growth took measures to reduce it. The figure shows age-sex pyramids of population A and B twenty years apart. Select the correct interpretation about them: [MR*] *(2009)*



a. A is earlier pyramid and no change has occurred in the growth rate
b. A is more recent and shows slight reduction in growth rate
c. B is earlier pyramid and shows stabilised growth rate
d. B is more recent showing that population is very young

56. Population of an insect species increases explosively during rainy season and then disappears at the end of the season. It shows: *(2007)*
a. Food plants mature and die at the end of rainy season
b. Population of predators increases enormously
c. Population growth curve is J-shaped
d. Population growth curve is S-shaped

57. Geometric representation of age structure is a characteristic of: *(2007)*
a. Biotic community b. Population
c. Ecosystem d. Landscape

58. Exponential population growth is represented by: *(2007)*
a. $dN/dt = rN$ b. $dt/dN = rN$
c. $dN/rN = dt$ d. $rN/dN = dt$

59. If the mean and median pertaining to a character in population are of the same value, which is likely to occur: *(2007)*
a. A bimodal distribution b. A T-shaped to occur
c. A skewed curve d. Normal distribution

60. Annual migration does not occur in case of: *(2006)*
a. Siberian b. Salamander
c. Arctic tern d. Salmon

61. The maximum growth rate occurs in: *(2004)*
a. Senescent phase b. Lag phase
c. Exponential phase d. Stationary phase

62. Certain characteristic demographic features of developing countries are: *(2004)*
a. High fertility, high density, rapidly rising mortality rate and a very young age distribution
b. High infant mortality, low fertility, uneven population growth and a very young age distribution
c. High mortality, high density, uneven population growth and a very old age distribution
d. High fertility, low or rapidly falling mortality rate, rapid population growth and a very young age distribution

63. Two opposite forces operate in the growth and development of every population. One of them relates to the ability to reproduce at a given rate. The force opposing it is called: *(2003)*
a. Morbidity b. Fecundity
c. Biotic potential d. Environmental resistance

64. In a population, unrestricted reproductive capacity is called as: *(2002)*
a. Biotic potential b. Fertility
c. Carrying capacity d. Birth rate

65. Choose the correct sequence of stages of growth curve for bacteria: *(2002)*
a. Lag, Log, Stationary, Decline phase
b. Lag, Log, Stationary phase
c. Stationary, Lag, Log, Decline phase
d. Decline, Lag, Log phase

66. The semilog of per minute growing bacteria is plotted against time. What will be the shape of graph? *(2002)*
a. Sigmoid b. Hyperbolic
c. Ascending straight line d. Descending straight line

67. The abundance of a species population, within its habitat, is called: [OS] *(1995)*
a. Relative density b. Regional density
c. Absolute density d. Niche density

Population Interactions

68. Given below are two statements:

Statement I: Gause's 'Competitive Exclusive Principle' states that two closely related species competing for the same related species competing for the same resources cannot co-exist indefinitely and competitively inferior one will be eliminated eventually. *(2023)*

Statement II: In general, carnivores are more adversely affected by competition than herbivores.

In the light of the above statements, choose the correct answer from the options given below:
a. Statement I is incorrect but Statement II is true
b. Both Statement I and Statement II are true
c. Both Statement I and Statement II are false
d. Statement I is correct but Statement II is false.

69. Match List-I with List-II *(2023)*

List-I (Interaction)		List-II (Species A And B)	
(A)	Mutualism	(I)	+(A), O(B)
(B)	Commensalism	(II)	−(A), O(B)
(C)	Amensalism	(III)	+(A), -(B)
(D)	Parasitism	(IV)	+(A), +(B)

Choose the correct answer from the given options:
a. A-III, B-I, C-IV, D-II b. A-IV, B-II, C-I, D-III
c. A-IV, B-I, C-II, D-III d. A-IV, B-III, C-I, D-II

70. Match List-I with List-II. [MR*] *(2023)*

List-I (Interacting species)		List-II (Name of Interaction)	
(A)	A Leopard and a Lion in a forest/ grassland	(I)	Competition
(B)	A Cuckoo laying egg in a Crow's nest	(II)	Brood parasitism
(C)	Fungi and root of a higher plant in Mycorrhizae	(III)	Mutualism
(D)	A cattle egret and a Cattle in a field	(IV)	Commensalism

Choose the correct answer from the options given below:
a. A-II, B-III, C-I, D-IV b. A-I, B-II, C-III, D-IV
c. A-I, B-II, C-IV, D-III d. A-III, B-IV, C-I, D-II

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71. Plants offer rewards to animals in the form of pollen and nectar and the animals facilitate the pollination process. This is an example of: *(2023-Manipur)*

a. Amensalism b. Competition
c. Commensalism d. Mutualism

72. The species of plants that plays a vital role in controlling the relative abundance of other species in a community is called ..... . *(2023-Manipur)*

a. alien species b. endemic species
c. exotic species d. keystone species

73. For chemical defence against herbivores, *Calotropis* has: *(2023-Manipur)*

a. cardiac glycosides b. strychnine
c. toxic ricin d. distasteful quinine

74. Two butterfly species are competing for the same nectar of a flower in a garden. To survive and coexist together, they may avoid competition in the same garden by *(2022 Re)*

a. predating on each other
b. feeding at the same time
c. choosing different foraging patterns
d. increasing time spent on attacking each other

75. While explaining interspecific interaction of population, (+) sign is assigned for beneficial interaction, (–) sign is assigned for detrimental interaction and (0) for neutral interaction. Which of the following interactions can be assigned (+) for one species and (–) for another species involved in the interaction? *(2022)*

a. Competition b. Predation
c. Amensalism d. Commensalism

76. Which one of the following statements **cannot** be connected to Predation? *(2022)*

a. It is necessitated by nature to maintain the ecological balance
b. It helps in maintaining species diversity in a community
c. It might lead to extinction of a species
d. Both the interacting species are negatively impacted

77. Inspite of interspecific competition in nature, which mechanism the competing species might have evolved for their survival? *(2021)*

a. Competitive release b. Mutualism
c. Predation d. Resource Partitioning

78. Amensalism can be represented as: *(2021)*

a. Species A (+) ; Species B (+)
b. Species A (-) ; Species B (-)
c. Species A (+) ; Species B (0)
d. Species A (-) : Species B (0)

79. Match the items in Column I with those in Column II: **[MR*]** *(2020-Covid)*

	Column - I		Column - II
1.	Herbivores-Plants	(i)	Commensalism
2.	Mycorrhiza-Plants	(ii)	Mutualism
3.	Sheep-Cattle	(iii)	Predation
4.	Orchid-Tree	(iv)	Competition

	(1)	(2)	(3)	(4)
a.	(iii)	(ii)	(iv)	(i)
b.	(ii)	(i)	(iii)	(iv)
c.	(i)	(iii)	(iv)	(ii)
d.	(iv)	(ii)	(i)	(iii)

80. Match Column - I with Column - II **[MR*]** *(2019)*

	Column - I		Column - II
A.	Saprophyte	i.	Symbiotic association of fungi with plant roots
B.	Parasite	ii.	Decomposition of dead organic materials
C.	Lichens	iii.	Living on plants or animals
D.	Mycorrhiza	iv.	Symbiotic association of algae and fungi

Choose the correct answer from the option given below

	(A)	(B)	(C)	(D)
a.	(i)	(ii)	(iii)	(iv)
b.	(iii)	(ii)	(i)	(iv)
c.	(ii)	(i)	(iii)	(iv)
d.	(ii)	(iii)	(iv)	(i)

81. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other? *(2018)*

a. *Hydrilla* b. *Yucca*
c. Banana d. *Viola*

82. Which one of the following population interactions is widely used in medical science for the production of antibiotics? *(2018)*

a. Commensalism b. Mutualism
c. Parasitism d. Amensalism

83. Mycorrhizae are the example of: *(2017-Delhi)*

a. Fungistasis b. Amensalism
c. Antibiosis d. Mutualism

84. The principle of competitive exclusion was stated by: *(2016 - II)*

a. MacArthur b. Verhulst and Pearl
c. C.Darwin d. G.F. Gause

85. If '+' sign is assigned to beneficial interaction, '–' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+' '–' refers to: *(2016 - II)*

a. Commensalism b. Parasitism
c. Mutualism d. Amensalism

86. Gause's principle of competitive exclusion states that: *(2016 - I)*

a. More abundant species will exclude the less abundant species through competition
b. Competition for the same resources excludes species having different food preferences
c. No two species can occupy the same niche indefinitely for the same limiting resources
d. Larger organisms exclude smaller ones through competition

87. In which of the following interactions both partners are adversely affected? *(2015 Re)*

a. Predation b. Parasitism
c. Mutualism d. Competition

88. A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is: **[OS]** *(2013)*

a. Amensalism b. Ectoparasitism
c. Symbiosis d. Commensalism

89. *Cuscuta* is an example of: *(2012 Mains)*

a. Ectoparasitism b. Brood parasitism
c. Predation d. Endoparasitism

90. Consider the following statement (A)-(D) each with one or two blanks.

A. Bears go into (1) during winter to (2) cold weather
B. A conical age pyramid with a broad base represents (3) human population
C. A wasp pollinating a fig flower is an example of (4)
D. An area with high levels of species richness is known as (5)

Which one of the following options, gives the correct fill ups for the respective blank numbers from (1) to (5) in the statements? **[MR*]** *(2012 Pre)*

a. (3) - expanding, (4) - commensalism, (5) - biodiversity park
b. (1) - hibernation, (2) - escape, (3) - expanding, (5) - hot spot
c. (3) - stable, (4) - commensalism, (5) - marsh
d. (1) - aestivation, (2) - escape, (3) - stable, (4) - mutualism

91. Which one of the following is categorised as a parasite in true sense? **[OS]** *(2011 Pre)*

a. The cuckoo (Koel) lays its egg in crow's nest
b. The female *Anopheles* bites and sucks blood from humans
c. Human foetus developing inside the uterus draws nourishment from the mother
d. Head louse living on the human scalp as well as laying eggs on human hair

92. Which is appropriately defined? *(2010 Mains)*

a. Host is an organism which provides food to another organism
b. Amensalism is relationship in which one species is benefitted while the other is unaffected
c. Predator is an organism that catches and kills other organisms for food
d. Parasite is an organism which always lives inside the body of other organism and may kill it

93. Praying mantis is a good example of: **[OS]** *(2006)*

a. Camouflage b. Warning coloration
c. Mullerian mimicry d. Social insect

94. Niche overlap is: **[OS]** *(2006)*

a. Mutualism between two species
b. Active cooperation between two species
c. Two different parasites on same host
d. Sharing resources between two species

95. Animals have innate ability to escape from predation. Select the incorrect example: **[OS]** *(2005)*

a. Colour change in chameleon
b. Enlargement of body by swallowing air in puffer fish
c. Poison fangs of snakes
d. Melanin in moths

96. Which is not true for species? *(2005)*

a. Members of species can interbreed
b. Each species is reproductively isolated from every other species
c. Gene flow does not occur between populations of a species
d. Variations occur among members of a species

97. Which type of association is found in between entomophilous flower and pollinating agent? *(2002)*

a. Mutualism b. Commensalism
c. Co-operation d. Convolution

98. Which of the following is a correct pair? **[OS]** *(2002)*

a. *Cuscuta* - parasite b. *Dischidia* - insectivorous
c. *Opuntia* - predator d. *Capsella* - hydrophyte

99. What is true for individuals of same species? *(2002)*

a. Live in same niche b. Live in same habitat
c. Interbreeding d. Live in different habitat

100. Two different species can not live for long duration in the same niche or habitat. This law is: *(2002)*

a. Allen's law
b. Bergmann's law
c. Competitive exclusion principal
d. Weismann's theory

101. What will be happen if the number of organism increased at a place? *(1999)*

a. Interspecies competition
b. Intraspecies competition
c. Both (a) and (b)
d. None of the above

102. A male insect mistakes a flower of orchid to be its female due to shape and perform the act of copulation and induce pollination. This is an example of: **[OS]** *(1998)*

a. Mimicry b. Pseudocopulation
c. Pseudopollination d. None

103. Which one of the following pairs is correctly matched? **[OS]** *(1995)*

a. Parasitism - Intraspecific relationship
b. Uricotelism - Aquatic habitat
c. Excessive perspiration - Xeric adaptation
d. Stream lined body - Aquatic adaptation

104. Association of animals when both partners are benefitted: *(1993)*

a. Colony b. Mutualism
c. Commensalism d. Ammensalism

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105. Which one is true? [MR*] *(1991)*

a. Commensalism when none of the interacting populations affect each other

b. Symbiosis when the interaction is useful to both the populations

c. Symbiosis when neither populations affects each other

d. Commensalism when the interaction is useful to both the populations

106. The relation between algae and fungi in a lichen is: *(1989)*

a. Symbiosis b. Parasitism

c. Commensalism d. Protoco-operation

107. Competition for light, nutrients and space is most severe between: *(1988)*

a. Closely related organism growing in different niches

b. Closely related organisms growing in the same area/niche

c. Distantly related organisms growing in the same habitat

d. Distantly related organisms growing in different niches

108. Phenomenon of organisms resembling others for escaping from enemies is: *(1992)*

a. Adaptation b. Mimicry

c. Homology d. Analogy

109. Association between sucker fish (*Remora*) and shark is. [OS] *(1989)*

a. Commensalism b. Symbiosis

c. Predation d. Parasitism

110. A mutually beneficial association necessary for survival of both partners is: *(1988)*

a. Mutualism/symbiosis b. Commensalism

c. Amensalism d. Both (a) and (b)

111. A high density elephant population in an area will result in: *(2003)*

a. Mutualism b. Predation on one another

c. Interspecific competition d. Intraspecific competition

Answer Key

1. (d)	**2.** (b)	**3.** (a)	**4.** (d)	**5.** (a)	**6.** (b)	**7.** (b)	**8.** (c)	**9.** (b)	**10.** (d)
11. (a)	**12.** (c)	**13.** (a)	**14.** (c)	**15.** (a)	**16.** (d)	**17.** (d)	**18.** (a)	**19.** (c)	**20.** (b)
21. (c)	**22.** (b)	**23.** (d)	**24.** (b)	**25.** (b)	**26.** (b)	**27.** (b)	**28.** (c)	**29.** (d)	**30.** (b)
31. (b)	**32.** (d)	**33.** (d)	**34.** (c)	**35.** (a)	**36.** (b)	**37.** (b)	**38.** (c)	**39.** (a)	**40.** (b)
41. (b)	**42.** (b)	**43.** (b)	**44.** (c)	**45.** (c)	**46.** (b)	**47.** (a)	**48.** (b)	**49.** (a)	**50.** (c)
51. (a)	**52.** (d)	**53.** (d)	**54.** (d)	**55.** (b)	**56.** (c)	**57.** (b)	**58.** (a)	**59.** (d)	**60.** (b)
61. (c)	**62.** (d)	**63.** (d)	**64.** (a)	**65.** (a)	**66.** (c)	**67.** (d)	**68.** (d)	**69.** (c)	**70.** (b)
71. (d)	**72.** (d)	**73.** (a)	**74.** (c)	**75.** (b)	**76.** (d)	**77.** (d)	**78.** (d)	**79.** (a)	**80.** (d)
81. (b)	**82.** (d)	**83.** (d)	**84.** (d)	**85.** (b)	**86.** (c)	**87.** (d)	**88.** (d)	**89.** (a)	**90.** (b)
91. (d)	**92.** (c)	**93.** (a)	**94.** (d)	**95.** (c)	**96.** (c)	**97.** (a)	**98.** (a)	**99.** (c)	**100.** (c)
101. (c)	**102.** (b)	**103.** (d)	**104.** (b)	**105.** (b)	**106.** (a)	**107.** (b)	**108.** (b)	**109.** (a)	**110.** (a)
111. (d)									

Explanations

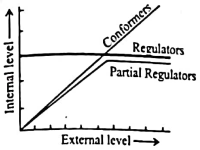
1. **(d)** Ecological niche describes how an organism or population responds to the distribution of resources and whole environment.

2. **(b)** Tropical rain forest is harboring many tree dwelling animals.

3. **(a)** Every winter the famous Keolado national park (Bharatpur) in Rajasthan host thousands of migratory birds coming from Siberia.

4. **(d)** Large Woody Vines are more commonly found in Tropical Rainforest.

5. **(a)**



6. **(b)** At 40° North and South the heat gain through insulation approximately equal to the heat loss through terrestrial radiation.

7. **(b)** Diurnal temperature is variation between maximum and minimum temperature of a day. Diurnal temperature of different regions are affected by different factors. High desert regions typically have the greatest diurnal - temperature variations.

8. **(c)** Pedocal is a class of soils which form in semiarid and arid regions and are rich in calcium carbonate. Black soil is rich in metals such as iron, magnesium and aluminium.

9. **(b)** Dominant gene are more frequently found in plant species.

10. **(d)** Soil pH is a measure of acidity and alkalinity in soils. Optimal pH range for most plants is between 5.5 and 7.0.

11. **(a)** In ecology, a community is made up of populations of different species inhabiting the same geographical area, so it accounts for both-biotic and abiotic components of an ecosystem.

12. **(c)** Thorn forests are xeric shrubland ecoregion, which have thorny shrubs such as *Acacia*, *Prosopis* and *Caparis*.

13. **(a)** Ecological niche describes how an organism or population responds to the distribution of resource & the environment.

14. **(c)** Benthic organisms are attached or rest on the bottom sediments.

15. **(a)** Ecology is the branch of biology that deals with the study of relationship of organisms among themselves & to the environment.

16. **(d)** Species is a population of organisms that are alike, inhabit same area & moreover they can interbreed.

17. **(d)** Greater the number of lives sustain by soil, greater is its fertility. A fertile soil is capable of holding nutrients and water to support the living system inhabiting that soil.

18. **(a)** Soil particles determines its texture. The soil particles enclose living spaces in between them called pore space. In coarse textured soils, the pore space is wide but pore frequency is low. But in fine textured soil, the pore space is narrow but pore frequency is high.

19. **(c)** Deep black soil is productive due to high proportion of clay and humus. These are the richest in nutrients and therefore these soils are the most fertile.

20. **(b)** Homeostasis is the stable state of an organism maintained by adjusting to the conditions that are optimal for survival.

21. **(c)** Both (A) and (R) are true and (R) is the correct explanation of (A).

At high altitudes, the atmospheric pressure is lower than at sea level, which means that the oxygen pressure is also lower. This lower oxygen availability can lead to altitude sickness, characterised by symptoms such as breathing difficulty and heart palpitations.

22. **(b)** According to Allen's rule, mammals from colder climates generally have shorter ears and limbs to minimise heat loss. Polar seal have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces loss of body heat.

In the absence of an external source of water, the kangaroo rat in North American deserts is capable of meeting all its water requirements through its internal fat oxidation. It exhibits physiological adaptation.

Desert lizards show behavioural adaptation. They bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing.

Marine fishes at depth are adapted biochemically to survive in great depths in ocean.

23. **(d)** Altitude sickness can be experienced at high altitudes. Its symptoms include nausea, fatigue and heart palpitations. This is because in the low atmospheric pressure of high altitudes, the body does not get enough oxygen.

24. **(b)** Halophytes growing in saline soils show

(i) Vivipary which is *in-situ* seed germination

(ii) Pneumatophores for gaseous exchange

25. **(b)** It is much easier for a small animal to run uphill than for a large animal because smaller animals have a higher metabolic rate.

26. **(b)** Archaebacteria flourish in hot spring and deep sea hydrothermal vents.

27. **(b)** As a person moves up a hill, the pO_2 and total atmospheric pressure decreases. Decrease in pO_2 due to increasing altitude, stimulates the JG - cells of kidney to secrete erythropoietin hormone, increasing the number of RBCs (polycythemia) to compensate the supply of O_2. At higher altitude, haemoglobin has lower binding affinity to O_2 because the primary factor responsible for binding is pO_2, which decreases at higher altitude.

28. **(c)** Desert lizards lack the physiological ability that mammals have to deal with the high temperatures of their habitat, but manage to keep their body temperature fairly constant by behavioral means. They bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing.

29. **(d)** At higher altitudes, atmospheric oxygen is less, as a result, more RBC are needed to absorb the required amount of O_2 to survive.

30. **(b)** *Opuntia* is a xerophytic plant. It is well adapted to extreme hot conditions. Its leaves modified into spine to reduce transpiration while stem started photosynthesis.

31. **(b)** In hydrophytes, vascular tissue and mechanical tissue are reduced. Cuticle is very reduced or absent.

32. **(d)** In the absence of external water source, kangaroo rat in North America is capable of meeting all its water requirements through its internal fat oxidation. It has ability to concentrate its urine.

33. **(d)** At higher altitudes, atmospheric oxygen is less, as a result, more RBC are needed to absorb the required amount of O_2 to survive.

34. **(c)** Mimicry is an adaptation of organism to either predate on prey or to protect themselves from harmful encounters by deceiving enemies.

35. **(a)** Sunken stomata is a stomata in small pit, which protects the escaping water vapour from air currents, decreasing water from leaf. These are commonly found in plants in arid environment. *E.g.*, *Nerium*, it has leaf with sunken stomata, a typical structure of xerophytic leaf.

36. **(b)** Fossorial animal are burrowing animals, mostly adapted to digging and lives underground.

37. **(b)** Therophytes are annual plants that completes the life in a short period under favourable conditions and survive harsh conditions by their seeds.

38. **(c)** Allen's rule: Animals adapted to cold climates have shorter limbs & body appendages than in animals of same species living in warm climates.

39. **(a)** At high altitude, where oxygen is sparse, RBC production in human blood increases such that more number of oxyhaemoglobin complex is formed and the oxygen requirement of body cells can be achieved.

40. **(b)** Logistic growth – A population growing in a habitat with limited resources.

Exponential growth – Any species growing exponentially under unlimited resource conditions can reach enormous population densities in a short time.

Expanding age pyramids – The percent individuals of pre-reproductive age is largest followed by reproductive and post reproductive age groups.

Stable age pyramid – The percent individuals of pre-reproductives and reproductive age group are same.

41. **(b)** 9

The population increased from 250 to 2500, which is an increase of 2250 snails. The birth rate per snail is the increase divided by the original number of snails, which is 2250/250, resulting in 9 births per snail per year.

42. **(b)** Total number of *Drosophila* = 80

Number of *Drosophila* died = 8

Death rate = Number of death / Total number of individual in a population

$= 8 / 80$

$= 0.1$

Therefore, the death rate in the population is 0.1 individuals per *Drosophila* per week.

43. **(b)** In exponential growth, the integral form of the growth equation is represented as:

$N_t = N_o e^{rt}$

Here, N_t is the population density after time t

N_o is the population density at time zero

r is the intrinsic rate of natural increase

e is the base of natural logarithms (2.71828)

44. **(c)** Species interaction is not an attribute of a population.

45. **(c)** Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration. Immigration contribute to an increase in population density.

46. **(b)** Ratio of number of births to size of population is called natality or birth rate.

47. **(a)** Growing population – Upright pyramid ⇒ pre-reproductive > reproductive > post - reproductive.

Stable population - Bell shaped pyramid ⇒ pre-reproductive ≥ reproductive > post - reproductive

Constrictive ⇒ Low percentage of younger people and declining birth rate.

48. **(b)** A population growing in a habitat with limited resources shows logistic growth curve.

For logistic growth

$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

If K = N then $\frac{K-N}{K} = 0$,

$\therefore \frac{dN}{dt} = 0$,

the population reaches asymptote.

49. **(a)** When N/K is exactly one, the growth rate of a population following the logistic model equal zero.

50. **(c)** Large number of progeny with small size is correct for r-selected species.

51. **(a)** (B + I) - (D + E) = Net increase in population.

52. **(d)** $dN/dt = rN\left(\frac{K-N}{K}\right)$ This type of population growth is called Verhulst-Pearl Logistic Growth.

53. **(d)** Declining population has urn shaped pyramid with least number of pre-reproductive individuals

54. **(d)** Natality, mortality and sex ratio are attributes of population while stratification is characteristic of biotic community.

55. **(b)** Government took necessary steps to reduce the populations in a given pyramids. 'A' pyramid shrinked agewise hence 'A' is recent shows slight reduction in growth rate.

56. **(c)** Population growth is J-shaped in which density increases rapidly in exponential fashion and then stops abruptly as environmental resistance or another limiting factor becomes effective more or less suddenly.

57. **(b)** Geometric representation of age structure is a characteristic of population. In most population, individuals are of different genes. The proportion of individual in each age group is called age structure of that population.

58. **(a)** $\frac{dN}{dt} = rN$ (Equation of exponential growth)

59. **(d)** For a normal distribution, the mean, median and the mode are actually equivalent.

60. **(b)** Salamander undergo hibernation. Salmon are anadromous they undergo spawning for 4 years. Siberian crane and arctic tern travels thousand Kilometres during winter and come back during summer.

61. **(c)** Exponential phase is characterised by doubling of population also called logarithmic phase.

62. **(d)** Many developing countries like India, China show highly fertile population, that is rapidly increasing the population of these countries. Decrease in death rate due to advance medical facilities, also contribute to this. Young age distribution in such countries make the population reproductive.

63. **(d)** Environmental resistance is a force that is due to the sum of the environment factors (drought, competition, etc.) that tend to restrict the biotic potential of an organism and impose a limit on its numerical increase.

64. **(a)** Maximum capacity of an individual to reproduce under optimal environment conditions is termed as biotic potential of that organism.

65. **(a)** Bacterial growth always follow a pattern of four phases - Lag phage, where very little growth occurs followed by log phase, when number of bacterial cells doubles; stationary phase is third phase characterised by no net growth in population as rate of death equals rate of growth and the last phase is decline or death phase.

66. **(c)** Semi - log commonly used to illustrate the change in number of microbes due to asexual reproduction. It turns out to be a linear curve.

67. **(d)** Niche density is estimated as within species mean trait distances, hence smaller the distances, greater the abundance and greater the niche density of a species.

68. **(d)** Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.

In general, herbivores and plants appear to be more adversely affected by competition than carnivores.

69. **(c)** **Mutualism:** This interaction confers benefits on both the interacting species.

Commensalism: This is the interaction in which one species benefit (+) and other in neutral (o).

Amensalism: In this interaction one species is harmed (–) whereas the other in unaffected (o).

Parasitism: In this interaction one species benefit (+) and other is harmed (–).

70. **(b)** Competition is a -/- interaction that occurs when individuals of different species compete for a resource that limits the survival and reproduction of each species, e.g., a leopard and a lion in a forest or grassland.

Brood parasitism or the laying of one's eggs in the nest of another individual, is a reproductive strategy whereby parasites foist the cost of rearing their offspring onto another individual, the host, e.g., a cuckoo laying eggs in a crow's nest.

Mutualism is an interspecific interaction that benefits both species (+/+), e.g., fungi and roots of a higher plant in mycorrhizae.

Commensalism is the interaction in which one species benefits and the other is neither harmed nor benefited, e.g., a cattle egret and a cattle in a field.

71. **(d)** Mutualism

Some plants and their pollinators form mutualistic relationships, as plants offer rewards to animals in the form of pollen/ nectar and the animals/ insects in return help in facilitating pollination.

72. **(d)** Keystone species.

A keystone species is a plant or animal species that plays an important role in an ecosystem. It plays a vital role in controlling the relative abundance of other species in a community.

73. **(a)** Cardiac glycosides

Calotropis produces cardiac glycosides, which are toxic compounds deterring herbivores from consuming the plant.

74. **(c)** To avoid competition for the same nectar source, butterfly species may adopt different foraging patterns. This differentiation allows multiple species to coexist in the same habitat by reducing direct competition for resources.

75. **(b)** Interspecific interactions arise from the interaction of populations of two different species. They could be beneficial, detrimental or neutral (neither harm nor benefit) to one of the species or both. While explaining interspecific interaction of population, (+) sign is assigned for beneficial interaction, (–) sign is assigned for detrimental interaction and (0) for neutral interaction.

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Competition can be assigned (-) for both species involved in the interaction.

Predation can be assigned (+) for one species and (-) for another species involved in the interaction.

Amensalism can be assigned (-) for one species and (0) for another species involved in the interaction.

Commensalism can be assigned (+) for one species and (0) for another species involved in the interaction.

76. **(d)** Predation is a population interaction in which only one species benefits while the other is negatively affected or harmed. Predators help to maintain the ecological balance among organisms by consuming prey and by altering prey behavior and prey habitat selection. Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species. Predation might lead to extinction of a species. For example, if a predator is too efficient and overexploits its prey, then the prey might become extinct and following it, the predator will also become extinct for lack of food.

77. **(d)** In case of competition, species have evolved a mechanism called 'Resource Partitioning' in order to co-exist. In this, species avoid competition by choosing different times for feeding or different foraging patterns. This process will not lead to the exclusion of species.

Competitive release is the process in which a species whose distribution is restricted to a small geographical area because of the presence of a competitively superior species, is found to expand its distributional range dramatically when the competing species is experimentally removed.

Mutualism is a type of interaction in which both the species that are interacting with each other are benefitted.

Predation is a type of interaction in which one species is benefitted and other is harmed.

78. **(d)** Amensalism is a part of interspecific interactions among the organisms. In this case, one species face the negative effect while there is no effect on the other species. It is represented as Species A (–) and Species B (0).

Species A (+) : Species B (0) interaction is observed in commensalism.

Species A (+) : Species B (+) interaction is observed in mutualism.

Species A (–) : Species B (–) interaction is observed in competition

79. **(a)** Animals eating plants are categorised separately as herbivores. These are example of predation. The mycorrhizae are associations between fungi and the roots of higher plants. They shows mutualism. The sheep and cattle compete for the food and therefore it is an example of competition interaction. An orchid growing as an epiphyte on a mango branch is an example of commensalism.

80. **(d)**

Saprophytes	-	Decomposition of dead organic materials
Parasites	-	Grow on/in living plants and animals
Lichens	-	Symbiotic association of algae and fungi
Mycorrhiza	-	Symbiotic association of fungi with plant roots

81. **(b)** No other species besides the moth pollinates *Yucca* flowers, similarly *Yucca* moth larvae don't feed on anything other than *Yucca* seeds. So, they show symbiotic relationship.

82. **(d)** Amensalism (–, 0) type of relationship where one is harmed and other remains unaffected. Antibiotics are harmful for bacteria but do not affect human beings.

83. **(d)** Mycorrhizae is a symbiotic association of fungi with roots of higher plants.

84. **(d)** The principle of competitive exclusion was stated by G.F. Gause.

Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.

85. **(b)**

Species A	Species B	Name of Interaction
+	+	Mutualism
–	–	Competition
+	–	Predation
+	–	Parasitism
+	0	Commensalism
–	0	Amensalism

86. **(c)** Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.

87. **(d)** Competition is the relationship in which each population adversely affects the other in the struggle for resources in short supply.

88. **(d)** The association between sea anemone and hermit crab is a type of commensalism.

89. **(a)** *Cuscuta* is a parasitic plant, commonly found growing on hedge plants. It derives its nutrition from the host plant which it parasites as *Cuscuta* lost its chlorophyll & leaves in the course of evolution.

90. **(b)**

91. **(d)** Parasites evolved special adaptations such as the loss of unnecessary sense organs, presence of adhesive organs or suckers to cling on to the host, loss of digestive system and high reproductive capacity.

Only head louse living on the human scalp as well as laying eggs on human hair shows parasite in true sense.

The cuckoo (Koel) lays its egg in crow's nest shows brood parasitism.

92. **(c)** Predator is an organism that catches and kills the prey for food. Parasite may live inside or outside the host. Amensalism relationship in which one is harmed while another is unaffected.

93. **(a)** Camouflage is the ability to blend with the surrounding or background. It is the most common animals adaptation to remains unnoticed for protection.

94. **(d)** Niche overlap: It is a measure of the association of two or more species. This indicates their similar habitat requirement, it is also an indicator of competition if resources are limited.

95. **(c)** Animals resist predation by cryptic coloration, deceptive, behavior defense and possession of mechanical or chemical defenses.

E.g., enlargement of body size by swallowing air in puffer fish, melanism in moths, colour change in chameleon.

96. **(c)** Gene flow ensures that all population of a given species share a common gene pool. Gene flow should be interrupted between populations.

97. **(a)** Plant - pollinator interactions is characterised by mutualism. Pollinators are beneficial to plants by pollinating their flowers and in turn plants provide them nectar and other nutrition.

98. **(a)** *Cuscuta* is a parasitic plant. They can't perform photosynthesis as they lack chlorophyll, and hence grow on other using their nutrients for growth.

99. **(c)** Individuals of same species are capable of exchanging genes or interbreed.

100. **(c)** Competitive exclusion principle (Gauses's law) states that two species competing for the same limiting resource in same habitat cannot coexist at constant population values.

101. **(c)** With the overproduction of a population, the resources to sustain their life starts to become a limiting factor. Limited availability of resources in population inhabiting same area, starts a struggle among them for their existence. This all leads to a nature of competition between two species (interspecific) or between two individuals of same species (intraspecific).

102. **(b)** Orchids have evolved sexual mimicry for pollination. Male insects are deceived by orchids, as orchids mimic the female mating signals and attract male insects to let pollination occur.

103. **(d)** Streamlined body lowers the friction drag between a fluid.

104. **(b)** Mutualism is a type of relationship among organisms, where both the involved partners are benefitted by each other. It is a (+,+) type of ecological relationship.

105. **(b)** Commensalism is (+, 0) type of interaction, i.e., one is benefitted and other remains unaffected. Symbiosis is (+, +) type of interaction where both the partners are benefitted by each other and thus lives together.

106. **(a)** Lichens show the symbiotic relationship between fungi and algae in which one provides nutrition and other provides shelter and support.

107. **(b)** Species living in the same area are more susceptible to face the competition among each other as they compete for common resources.

108. **(b)** Adaptation enables the organism to survive and reproduce in its habitat. Mimicry is an example of long term adaptation, in which there is a close resemblance of an organism to the surrounding in order to avoid detection, e.g., leaf insect *Phyllium*.

109. **(a)** Sharks and *Remora* fish work together. A not so picky eater the *Remora* fish attaches itself to the shark. It allows the *Remora* to travel to different areas without having to expend its own energy to swim. The shark is completely unaffected by the *Remora's* presence

110. **(a)** In symbiosis or mutualism, both the partners are benefitted and survive together.

111. **(d)** Intraspecific competition is an important density dependent factor regulating populations. Intraspecific competition occur between the members of same population.

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CHAPTER 12

Ecosystem

Ecosystem-Structure And Function

1. Which ecosystem has the maximum biomass? *(2017-Delhi)*
   a. Forest ecosystem b. Grassland ecosystem
   c. Pond ecosystem d. Lake ecosystem
2. The term ecosystem was coined by: *(2016 - I)*
   a. E.P. Odum b. A.G. Tansley
   c. E. Haeckel d. E. Warming
3. Which one of the following is a characteristic feature of cropland ecosystem? *(2016 - I)*
   a. Absence of soil organisms
   b. Least genetic diversity
   c. Absence of weeds
   d. Ecological succession
4. Vertical distribution of different species occupying different levels in a biotic community is known as: *(2015)*
   a. Zonation b. Pyramid
   c. Divergence d. Stratification
5. An association of individuals of different species living in the same habitual and having functional interactions is: *(2015 Re)*
   a. Biotic community b. Ecosystem
   c. Population d. Ecological niche
6. Which one of the following is not a functional unit of an ecosystem? *(2012 Pre)*
   a. Stratification b. Energy flow
   c. Decomposition d. Productivity
7. An ecosystem which can be easily damaged but can recover after some time if damaging effect stops will be having: *(2004)*
   a. High stability and low resilience
   b. Low stability and low resilience
   c. High stability and high resilience
   d. Low stability and high resilience
8. Which of the following is the most stable ecosystem? *(1995)*
   a. Mountain b. Ocean
   c. Forest d. Desert
9. What is true of ecosystem? *(1988)*
   a. Primary consumers are least dependent upon producers
   b. Primary consumers out-number producers
   c. Producers are more than primary consumers
   d. Secondary consumers are the largest and most powerful

Productivity

10. In the equation GPP – R = NPP *(2023)*
    GPP is Gross Primary Productivity
    NPP is Net Primary Productivity.
    R here is
    a. Reproductive allocation
    b. Photosynthetically active radiation
    c. Respiratory quotient
    d. Respiratory loss
11. The amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis is called: *(2022 Re)*
    a. Net primary production b. Secondary production
    c. Primary production d. Gross primary production
12. In the equation GPP- R = NPP. *(2021)*
    R represents:
    a. Retardation factor b. Environment factor
    c. Respiration losses d. Radiant energy
13. In relation to gross primary productivity and net primary productivity of an ecosystem, which one of the following statements is correct? [MR*] *(2020)*
    a. Gross primary productivity is always more than net primary productivity.
    b. Gross primary productivity and net primary productivity are one and same.
    c. There is no relationship between Gross primary productivity and net primary productivity
    d. Gross primary productivity is always less than net primary productivity.
14. In an ecosystem, the rate of production of organic matter during photosynthesis is termed as: *(2015)*
    a. Secondary productivity b. Net productivity
    c. Net primary productivity d. Gross primary productivity
15. Secondary productivity is rate of formation of new organic matter by: *(2013)*
    a. Decomposer b. Producer
    c. Parasite d. Consumer
16. The rate of formation of new organic matter by rabbit in a grassland is called: *(2012 Mains)*
    a. Net productivity b. Secondary productivity
    c. Net primary productivity d. Gross primary productivity
17. Biomass available for consumption by herbivores and decomposers is called: *(2010 Pre)*
    a. Secondary productivity
    b. Standing crop
    c. Gross primary productivity
    d. Net primary productivity
18. Highest annual net primary productivity is of: *(2007)*
    a. Tropical deciduous forest
    b. Temperate evergreen forest
    c. Temperate deciduous forest
    d. Tropical rain forest
19. Which of the following is expected to have the highest value ($gm/m^2/yr$) in a grassland ecosystem? *(2004)*
    a. Tertiary production b. Gross production (GP)
    c. Net production (NP) d. Secondary production
20. Which is the reason for highest biomass in aquatic ecosystem? [OS] *(2000)*
    a. Nanoplankton, blue green-algae, green algae
    b. Sea grass and slime moulds
    c. Benthic and brown algae
    d. Diatoms
21. Total amount of energy trapped by green plants in food is called: *(1998)*
    a. Gross primary production b. Net primary production
    c. Standing crop d. Standing state
22. Which of the following ecosystem has the highest gross primary productivity? [OS] *(1997)*
    a. Mangroves b. Rain forest
    c. Grassland d. Coral reef

Decomposition

23. Identify the correct statements: [MR*] *(2023)*
    A. Detrivores perform fragmentation
    B. The humus is further degraded by some microbes during mineralization.
    C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.
    D. The detritus food chain begins with living organisms.
    E. Earthworms break down detritus into smaller particles by a process called catabolism.
    Choose the correct answer from the options given below:
    a. D, E, A only b. A, B, C only
    c. B, C, D only d. C, D, E only

24. Given below are two statements: *(2022)*
    Statement I: Decomposition is a process in which the detritus is degraded into simpler substances by microbes.
    Statement II: Decomposition is faster if the detritus is rich in lignin and chitin
    In the light of the above statements, choose the correct answer from the options given below.
    a. Statement I is incorrect but Statement II is correct
    b. Both Statement I and Statement II are correct
    c. Both statement I and statement II are incorrect
    d. Statement I is correct but Statement II is incorrect
25. Detritivores breakdown detritus into smaller particles. This process is called. *(2022)*
    a. Decomposition b. Catabolism
    c. Fragmentation d. Humification
26. The rate of decomposition is faster in the ecosystem due to following factors EXCEPT: *(2020-Covid)*
    a. Warm and moist environment
    b. Presence of aerobic soil microbes
    c. Detritus richer in lignin and chitin
    d. Detritus rich in sugars
27. Which one of the following processes during decomposition is correctly described? *(2013)*
    a. Leaching: Water soluble inorganic nutrients rise to the top layers of soil
    b. Fragmentation: Carried out by organisms such as earthworm
    c. Humification: Leads to the accumulation of a dark colored substance humus which undergoes microbial action at a very fast rate
    d. Catabolism: Last step in the decomposition under fully anaerobic condition
28. The breakdown of detritus into smaller particles by earthworm is a process called: *(2011 Mains)*
    a. Mineralisation b. Catabolism
    c. Humification d. Fragmentation
29. Slow rate of decomposition of fallen logs in nature is due to: *(2008)*
    a. Anaerobic environment around them
    b. Low cellulose contents
    c. Low moisture content
    d. Poor nitrogen content
30. Plant decomposers are: *(2001)*
    a. Monera and fungi b. Fungi and plants
    c. Protista and Animalia d. Animalia and Monera
31. Which of the following acts as "nature's scavengers"? [OS] *(1997)*
    a. Insects b. Microorganisms
    c. Man d. Animals

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32. If we completely remove the decomposers from an ecosystem, its functioning will be adversely affected, because: *[OS]/(1995)*

a. Mineral movement will be blocked
b. The rate of decomposition will be very high
c. Energy flow will be blocked
d. Herbivores will not receive solar energy

Energy Flow & Ecological Pyramids

33. Which of the following statements is not correct ? *(2021)*

a. Pyramid of biomass in sea is generally upright.
b. Pyramid of energy is always upright.
c. Pyramid of numbers in a grassland ecosystem is upright.
d. Pyramid of biomass in sea is generally inverted.

34. Match the trophic levels with their correct species examples in grassland ecosystem. *(2020)*

	Column-I		Column-II
1.	Fourth trophic level	(i)	Crow
2.	Second trophic level	(ii)	Vulture
3.	First trophic level	(iii)	Rabbit
4.	Third trophic level	(iv)	Grass

a. 1-(iii) 2-(ii) 3-(i) 4-(iv)
b. 1-(iv) 2-(iii) 3-(ii) 4-(i)
c. 1-(i) 2-(ii) 3-(iii) 4-(iv)
d. 1-(ii) 2-(iii) 3-(iv) 4-(i)

35. Which of the following statements is incorrect? **[MR*]** *(2020-Covid)*

a. Energy content gradually increases from first to fourth trophic level
b. Number of individuals decreases from first trophic level to fourth trophic level
c. Energy content gradually decreases from first to fourth trophic level
d. Biomass decreases from first to fourth trophic level

36. Which of the following ecological pyramids is generally inverted? *(2019)*

a. Pyramid of numbers in grassland
b. Pyramid of energy
c. Pyramid of biomass in a forest
d. Pyramid of biomass in a sea

What type of ecological pyramid would obtained with the following data? *(2018)*

Secondary consumer : 120 g
Primary consumer : 60 g
Primary producer : 10 g

a. Inverted pyramid of biomass
b. Pyramid of energy
c. Upright pyramid of numbers
d. Upright pyramid of biomass

38. The primary producers of the deep-sea hydrothermal vent ecosystem are: *(2016 - II)*

a. Blue-green algae b. Coral reefs
c. Green algae d. Chemosynthetic bacteria

39. The mass of living material at a tropic level at a particular time is called: *(2015)*

a. Net primary productivity
b. Standing crop
c. Gross primary productivity
d. Standing state

40. Most animals that live in deep oceanic waters are: *(2015)*

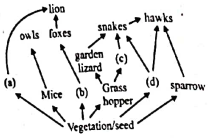
a. Secondary consumers b. Tertiary consumers
c. Detritivores d. Primary consumers

41. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain? *(2014)*

Plant → Mice → Snake → Peacock

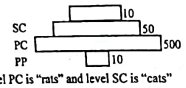
a. 0.0002 J b. 0.02 J
c. 0.002 J d. 0.2 J

42. Identify the likely organisms (a), (b), (c) and (d) in the food web shown below: **[MR*]** *(2012 Mains)*



	(a)	(b)	(c)	(d)
a.	Deer	Rabbit	Frog	Rat
b.	Dog	Squirrel	Bat	Deer
c.	Rat	Dog	Tortoise	Crow
d.	Squirrel	Cat	Rat	Pigeon

43. Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels? **[MR*]** *(2012 Pre)*



a. Level PC is "rats" and level SC is "cats"
b. Level PC is "insects" and level SC is "small insectivorous birds"
c. Level PP is "phytoplankton's" in sea and "whale" on top level TC
d. Level one PP is "pipal trees" and the level SC is "sheep

44. Identify the possible line "A" in the following food chain: Plant → insect → frog → "A" → Eagle: *(2012 Pre)*

a. Parrot b. Rabbit
c. Wolf d. Cobra

45. The upright pyramid of number is absent in: *(2012 Pre)*

a. Grassland b. Pond
c. Forest d. Lake

46. Which one of the following animals may occupy more than one tropic level in the same ecosystem at the same time? *(2011 Mains)*

a. Goat b. Frog
c. Sparrow d. Lion

47. Mass of living matter at a tropic level in an area at any time is called: *(2011 Pre)*

a. Standing state b. Standing crop
c. Detritus d. Humus

48. Of the total incident solar radiation, the proportion of PAR is: *(2011 Pre)*

a. More than 80% b. About 70%
c. About 60% d. Less than 50%

49. Which one of the following statements for pyramid of energy is incorrect, whereas the remaining three are correct? *(2011 Pre)*

a. It is upright in shape
b. Its base is broad
c. It shows energy content of different tropic level organisms
d. It is inverted in shape

50. Study statements (A - D) and select two correct one **[MR*]** *(2010 Pre)*

A. A Lion eating a Deer and a Sparrow feeding on grain are consumers
B. Predator, Star Fish *Pisaster*, helps in maintaining species diversity of some invertebrates
C. Predators ultimately lead to extinction of prey species
D. Plant chemicals like nicotine and strychnine are produced due to metabolic disorders

a. C and D b. A and D
c. A and B d. B and C

51. Which one of the following representations shows the pyramid of numbers in a forest ecosystem? *(2010 Mains)*

A. B.

C. D.

a. D b. A
c. B d. C

52. Which one of the following types of organisms occupies more than one tropic level in a pond ecosystem? *(2009)*

a. Phytoplankton b. Frog
c. Fish d. Zooplankton

53. Which two of the following statements about food chains are correct? *(2008)*

A. Removal of 80% tigers resulted in increased growth of vegetation
B. Removal of most carnivores resulted in increased population of deer

C. Length of food chain is limited to 3 - 4 tropic levels due to energy loss
D. Length of food chain may vary from 2 - 3 tropic levels

a. A, D b. A, B
c. B, C d. C, D

54. Which of the following is not used for construction of ecological pyramids? *(2006)*

a. Fresh weight b. Dry weight
c. Number of individuals d. Rate of energy flow

55. Bamboo plant is growing in a far forest then what will be the trophic level of it? *(2002)*

a. First trophic level (T_1)
b. Second trophic level (T_2)
c. Third trophic level (T_3)
d. Fourth trophic level (T_4)

56. Percentage energy transferred to higher trophic level in food chain is: *(1999)*

a. 1% b. 10%
c. 90% d. 100%

57. The 10% energy transfer law of food chain was given by: *(1996)*

a. Lindemann b. Tansley
c. Stanley d. Weisman

58. In a biotic community, the primary consumers are: *(1995)*

a. Detritivores b. Herbivores
c. Carnivores d. Omnivores

59. The dominant second trophic level in a lake ecosystem is: *(1994)*

a. Phytoplankton b. Zooplankton
c. Benthos d. Plankton

60. Pyramid of numbers deals with number of: *(1993)*

a. Species in an area
b. Individuals in a community
c. Individuals in a tropic-level
d. Subspecies in a community

61. Pyramid of numbers in a pond ecosystem is: *(1993)*

a. Irregular b. Inverted
c. Upright d. Spindle shaped

62. Food chain in which microorganisms breakdown the food formed by primary producers is: *(1991)*

a. Parasitic food chain b. Detritus food chain
c. Consumer food chain d. Predator food chain

63. Pick up the correct food chain: *(1991)*

a. Grass → Chameleon → Insect bird
b. Grass → Fox → Rabbit → Bird
c. Phytoplankton → Zooplankton → Fish
d. Fallen leaves → Bacteria→ Insect larvae

64. Pyramid of numbers in a grassland tree ecosystem is: *(1991, 90)*

a. Always inverted b. Always upright
c. Both (a) and (b) d. Spindle-shaped

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Answer Key

1. (a)	2. (b)	3. (b)	4. (d)	5. (a)	6. (a)	7. (d)	8. (b)	9. (c)	10. (d)
11. (c)	12. (c)	13. (a)	14. (d)	15. (d)	16. (b)	17. (d)	18. (d)	19. (b)	20. (c)
21. (a)	22. (b)	23. (b)	24. (d)	25. (c)	26. (c)	27. (b)	28. (d)	29. (c)	30. (a)
31. (b)	32. (a)	33. (a)	34. (d)	35. (a)	36. (d)	37. (a)	38. (d)	39. (b)	40. (c)
41. (b)	42. (a)	43. (b)	44. (d)	45. (c)	46. (c)	47. (b)	48. (d)	49. (d)	50. (c)
51. (d)	52. (c)	53. (c)	54. (a)	55. (a)	56. (b)	57. (a)	58. (b)	59. (b)	60. (a)
61. (c)	62. (b)	63. (c)	64. (b)						

Explanations

1. **(a)** The biomass is maximum in a forest ecosystem because of their size and longevity of trees. Forest ecosystem has formed the most massive and complex ecosystems of the earth.

2. **(b)** The term ecosystem was given by A.G. Tansley (1935).

3. **(b)** Cropland ecosystem is a manmade ecosystem having least genetic diversity.

4. **(d)** Vertical distribution of different species occupying the different levels is called stratification.

5. **(a)** Biotic community is a grouping of different but interacting population of different species which lives harmonious in a locality.

6. **(a)** Vertical distribution of different species occupying different levels is called stratification.

7. **(d)** Ecosystem susceptible to damage will have low stability and if it is able to recover that damage, then it shows high resilience.

8. **(b)** Roughly half of the total productivity occurs in the widespread oceans by microscopic phytoplanktons and thus making them a self-supporting, most stable ecosystem.

9. **(c)** Producers are consumed as food by primary consumers and therefore producers are always more in number than their consumers.

10. **(d)** Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP).

11. **(c)** Primary production refers to the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.

12. **(c)** Productivity is divided into Gross primary productivity (GPP) and Net primary productivity (NPP). When respiratory loss is subtracted from Gross primary productivity, net primary productivity is obtained. This is written as GPP – R = NPP. Here, 'R' is the respiratory loss. It is basically the amount of GPP used by plants during respiration.

13. **(a)** Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. Net primary productivity is equal to GPP minus respiration loss. Hence gross primary productivity is always more than NPP.

14. **(d)** Rate of production of organic matter during photosynthesis is termed as GPP. It is expressed in terms of g^{-2} yr^{-1} or (Kcal m^{-2}) y^{-1}. Net primary productivity is the available biomass for consumption of heterotrophs.

15. **(d)** Secondary productivity is defined as the rate of formation of new organic matter by consumers.

16. **(b)** Secondary productivity is defined as the rate of formation of new organic matter by consumers. Since rabbit is consumer the rate of new organic matters is secondary productivity.

17. **(d)** NPP = GPP - R

    Hence NPP is the available biomass for the consumption by the herbivores and decomposers.

18. **(d)** Productivity of tropical rain forest is highest. They contain more than 50% of total flora and fauna of the world.

19. **(b)** Gross primary production (GPP) is amount of chemical energy (as biomass) that primary producers create in a given period of time.

20. **(c)** Benthic and brown algae are phytoplanktons that contribute to greatest biomass in aquatic ecosystem like trees in forests.

21. **(a)** Gross primary production is total amount of chemical energy gets trapped in food by green plants. Some amount of this total energy is used by plants as respiration and rest amount is passed on to next trophic level called net primary production.

22. **(b)** Rain forests have highest gross primary productivity as these biomes are rich in producers (plants).

23. **(b)** Detritus food chain (DFC) begins with detritus or dead organic matter. Detrivores (eg. Earthworm, millipedes, slugs) perform fragmentation process on dead decaying material in any ecosystem. Humus a dark nutrient rich substance is degraded by microorganisms releasing inorganic nutrients into the soil. This process is known as mineralization. By the process leaching, water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

24. **(d)** Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition. In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.

25. **(c)** Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition. It occurs in 5 steps, namely fragmentation, leaching, catabolism, humification and mineralisation. Fragmentation is the process in which detritivores (e.g., earthworm) breakdown detritus into smaller particles. Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism. Humification refers to the conversion of dead and decaying organic matters into humus by decomposing bacteria, fungi and other microorganisms.

26. **(c)** Decomposition is largely an oxygen-requiring process. The rate of decomposition is controlled by chemical composition of detritus and climatic factors. In a particular climatic condition, decomposition rate is quicker, if detritus is rich in nitrogen and water-soluble substances like sugars. Warm and moist environment also favour decomposition.

27. **(b)** Leaching: Water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

    Catabolism: Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.

    Humification occur at extremely slow rate.

28. **(d)** Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation.

29. **(c)** If fallen logs are rich in nitrogen and sugar and warm and humid condition favors decomposition.

    If logs contain lignin and cold weather resists the decomposition.

30. **(a)** Most of the decomposers lie under the kingdoms monera and fungi. There are many bacteria and fungi, that decompose the dead parts of plant and break the organic compound into inorganic compounds, called plant decomposers.

31. **(b)** Microorganisms (bacteria and mould) are decomposers of the ecosystem. They feed upon dead decaying organisms (both plant and animals)

32. **(a)** Decomposers are saprotrophs which decompose the organic remains by secreting extracellular digestive enzymes. Thus, removal of decomposers results in blockage of mineral movement in an ecosystem.

33. **(a)** There are three types of ecological pyramids namely pyramid of number, biomass and energy.

    Pyramid of biomass in sea is generally inverted and not upright. This is so because the biomass of phytoplankton is less than biomass of zooplankton (fishes). Therefore, first statement is incorrect.

34. **(d)** Grassland ecosystem is a terrestrial ecosystem. It includes the following species at various trophic levels:

    First trophic level (T_1) – Grass

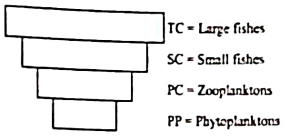
    Second trophic level (T_2) – Rabbit

    Third trophic level (T_3) – Crow

    Fourth trophic level (T_4) – Vulture

35. **(a)** Based on the source of their nutrition or food, organisms occupy a specific place in the food chain that is known as their trophic level. The amount of energy decreases at successive trophic levels. This means that energy content gradually decreases from first to fourth trophic level.

36. **(d)** The pyramid of biomass in sea is generally inverted because the biomass of fishes exceeds that of phytoplankton.



37. **(a)** Inverted pyramid will be obtained, as the base of the pyramid is determined by producers and consumers are positioned at the top.

38. **(d)** The primary producers of the deep-sea hydrothermal vent ecosystem are chemosynthetic bacteria.

39. **(b)** Each tropic level has a certain mass of living material at a particular time called as the standing crop. The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.

40. **(c)** In deep sea, little or no light penetrates and mostly organism live here rely for subsistence on falling organic matter produced in photic zone (or we can say dead bodies). Hence, animals that live in deep oceanic waters are scavengers or detritivores. They include crustaceans, polychaetes & some micro-organisms.

41. **(b)**

Plant	Mice	Snake	Peacock
20J	2J	0.2J	0.02J

42. **(a)** An organism (a), (b) and (d) is directly connected to vegetation hence, it must be primary consumer like deer, rabbit and rat respectively. Organism (c) is connected with grasshopper (primary consumer), hence it must be secondary consumer like frog (that eat on grasshopper).

43. **(b)** The consumers that feed on these herbivores are carnivores, or more correctly primary carnivores (though secondary consumers). Those animals that depend on the primary carnivores for food are labeled secondary carnivores.

44. **(d)** A series of organisms through which food energy flows in an ecosystem is called a food chain.

    Plant → Insect → Frog → Cobra → Eagle
    (Producer) (Herbivore) (1°Carnivore) (2°Carnivore) (3°Carnivore)

45. **(c)** Pyramid of number represents the number of individuals per unit area at various trophic levels. It is always upright in grassland, pond and lake ecosystems. But in forest or single tree ecosystem, it is spindle-shaped and if parasitic food chain is considered, then it will be an inverted pyramid.

46. **(c)** Among the following, only sparrow can occupy more than two tropic levels in same ecosystem because sparrow can feed on seeds/grains, i.e., herbivorous as well as feed on insects, i.e., carnivorous.

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47. **(b)** Standing crop: Each tropic level has a certain mass of living material at a particular time called as the standing crop

Standing state: The amount of nutrients, present in the soil at any given time, is referred to as the standing state. It varies in different kinds of ecosystems and also on a seasonal basis.

48. **(d)** Of the total incident solar radiation the proportion of PAR is 2-10%

49. **(d)** Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energy pyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area.

50. **(c)** Both Lion and Sparrow eating deer and seed respectively are consumers. *Pisaster* keeps the population of some species of invertebrates under check.

51. **(d)** Pyramid of number is spindle - shaped in a forest ecosystem because producers are mainly large trees which are less in number. 1° consumer like birds are more in numbers than producers, then number of secondary consumers gradually decreases.

52. **(c)** In pond ecosystems, fish occupy more than one tropic level. If it prey upon phytoplankton act as 1° consumer. If it prey upon zooplankton act as 2° consumer.

53. **(c)** Length of food chain is generally limited to 3 - 4 tropic levels due to energy losses. Predator keeps the prey population under check. If predator (carnivore) is removed deer population increases.

54. **(a)** Pyramid of number - No. of individuals
Pyramid of Biomass - Dry weight of living matter
Pyramid of energy - Rate of energy flow
But fresh weight is not used for construction of ecological pyramids

55. **(a)** Bamboo plant is a producer, so it will come in first trophic level of food chain.

56. **(b)** Transfer of energy from one trophic level to another trophic level follows 10% law, i.e., only & about 10% of energy from organic matter is stored as flesh and passed on to next level.

57. **(a)** Raymond Lindeman in 1942 introduced the ten per cent law of transfer of energy from one trophic level to the next.

58. **(b)** Primary consumers feed on producers, hence herbivores are called as primary consumers.

59. **(b)** In a lake ecosystem, first trophic level is covered by phytoplankton and second trophic level is occupied by zooplanktons.

60. **(c)** Number of organisms in trophic levels of a food chain is graphically represented in pyramid of numbers.

61. **(c)** Pyramid of number in a pond ecosystem is upright, i.e., producers are more in number with a broader base than number of consumers.

62. **(b)** Detritus food chain starts with dead organic matter which is broken down by decomposers into simple inorganic substances.

63. **(c)** In aquatic ecosystem, food chain is followed as: Phytoplanktons are eaten up by zooplanktons which, in turn, is consumed by fishes.

64. **(b)** Pyramid of number is always upright in a grassland ecosystem as number of plants are more than herbivores and number of herbivores are more than number of carnivores.

CHAPTER 13

Biodiversity and Conservation

Biodiversity & Patterns of Biodiversity

1. In 'rivet popper hypothesis', Paul Ehrlich compared the rivets in an airplane to: *(2023-Manipur)*
   a. species within a genus
   b. genetic diversity
   c. ecosystem
   d. genera within a family

2. Give the correct descending order of organisms with reference to their estimated number found in Amazon forest. [MR*] *(2022 Re)*
   (a) Plants
   (b) Invertebrates
   (c) Fishes
   (d) Mammals
   (e) Birds
   Choose the correct answer from the options given below
   a. (b) > (a) > (c) > (e) > (d) b. (a) > (b) > (e) > (d) > (c)
   c. (a) > (c) > (d) > (b) > (e) d. (b) > (a) > (e) > (d) > (c)

3. Frugivorous birds are found in large numbers in tropical forests mainly because of: *(2022 Re)*
   a. temperature conducive for their breeding
   b. lack of niche specialisation
   c. higher annual rainfall
   d. availability of fruits throughout the year

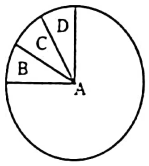
4. Which of the following regions of the globe exhibits highest species diversity? *(2020)*
   a. Madagascar
   b. Himalayas
   c. Amazon forests
   d. Western ghats of India

5. According to Robert May, the global species diversity is about: *(2020)*
   a. 20 million
   b. 50 million
   c. 7 million
   d. 1.5 million

6. According to Alexander von Humboldt: *(2020-Covid)*
   a. Species richness increases with increasing area, but only up to limit
   b. There is no relationship between species richness and area explored
   c. Species richness goes on increasing with increasing area of exploration
   d. Species richness decreases with increasing area of exploration

7. Alexander von Humboldt described for the first time: *(2017-Delhi)*
   a. Ecological Biodiversity
   b. Laws of limiting factor
   c. Species area relationships
   d. Population Growth equation

8. Given below is the representation of the extent of global diversity of invertebrates. What groups the four portions (A-D) represent respectively? [MR*] *(2014)*



	A	B	C	D
a.	Insects	Molluses	Crustaceans	Other animal groups
b.	Insects	Crustaceans	Other animal groups	Molluses
c.	Crustaceans	Insects	Molluses	Other animal groups
d.	Molluses	Other animal groups	Crustaceans	Insects

9. Which of the following represent maximum number of species among global biodiversity? *(2013)*
   a. Mosses and Ferns
   b. Algae
   c. Lichens
   d. Fungi

10. The highest number of species in the world is represented by: *(2012 Pre)*
    a. Lichens
    b. Fungi
    c. Mosses
    d. Algae

11. Which one of the following has the highest number of species in nature? *(2011 Pre)*
    a. Angiosperms
    b. Fungi
    c. Insects
    d. Birds

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12. Which one of the following shows maximum genetic diversity in India? *(2011 Pre)*
a. Mango b. Groundnut
c. Rice d. Maize

13. Which one of the following has maximum genetic diversity in India? *(2009)*
a. Tea b. Teak
c. Wheat d. Mango

14. Which one shows maximum species diversity from areas p - s? *(2008)*

Area and No. of habitats	Species, and their populations (in thousands) in the areas									
	A	B	C	D	E	F	G	H	I	J
p (11)	2.3	1.2	0.52	6.0	-	3.1	1.1	9.0	-	10.3
q (11)	10.2	-	0.62	-	1.5	3.0	-	8.2	1.1	11.2
r (13)	11.3	0.9	0.48	2.1	1.4	4.2	0.8	8.4	2.2	4.1
s (12)	3.2	10.2	12.1	4.8	0.4	3.3	0.8	7.3	11.3	2.1

a. s b. p
c. q d. r

15. Species diversity is maximum in: *(1999)*
a. Tropical rain forest b. Temperate forest
c. Deserts d. Hill slopes

16. The abundance of a species population, within its habitat, is called: **[OS]***(1995)*
a. Relative density b. Regional density
c. Absolute density d. Niche density

Importance & Loss of Biodiversity

17. Among 'The Evil Quartet', which one is considered the most important cause driving extinction of species? *(2023)*
a. Co-extinctions
b. Habitat loss and fragmentation
c. Over exploitation for economic gain
d. Alien species invasions

18. Which of the following is/are cause(s) of biodiversity losses? *(2023-Manipur)*
a. Over-exploitation, habitat loss and fragmentation
b. Climate change only
c. Over-exploitation only
d. Habitat loss and fragmentation only

Habitat loss and fragmentation, over exploitation, alien species invasion and co-extinction are causes for: *(2022)*
a. Natality b. Population explosion
c. Competition d. Biodiversity loss

Which of the following is the most important cause for animals and plants being driven to extinction? *(2019)*
a. Habitat loss and fragmentation
b. Drought and floods
c. Economic exploitation
d. Alien species invasion

21. Red list contains data or information on: *(2016 - II)*
a. Threatened species
b. Marine vertebrates only
c. All economically important plants
d. Plants whose products are in international trade

22. Which of the following is correctly matched? *(2016 - II)*
a. *Parthenium hysterophorus* – Threat to biodiversity
b. Stratification – Population
c. Aerenchyma – *Opuntia*
d. Age pyramid – Biome

23. Which of the following is the most important cause of animals and plants being driven to extinction? *(2016 - I)*
a. Over-exploitation
b. Alien species invasion
c. Habitat loss and fragmentation
d. Co-extinctions

24. The organisation which publishes the Red List of species is: *(2014)*
a. WWF b. ICFRE
c. IUCN d. UNEP

25. A species facing extremely high risk of extinction in the immediate future is called: *(2014)*
a. Extinct b. Vulnerable
c. Endemic d. Critically Endangered

26. Exotic species introduced in India are: *(2007)*
a. *Lantana camara*, water Hyacinth
b. Water Hyacinth, *Prosopis cineraria*
c. Nile Perch, *Ficus religiosa*
d. *Ficus religiosa*, *Lantana camara*

27. Which plant and animal represent endangered organisms in India? **[OS]***(2006)*
a. Banyan and Black Buck
b. Tamarind and Rhesus Monkey
c. *Cinchona* and Leopard
d. *Bentinckia nicobarica* and Red Panda

28. According to IUCN Red List, what is the status of Red Panda (*Ailurus fulgens*)? **[OS]***(2005)*
a. Critically endangered b. Endangered species
c. Vulnerable species d. Extinct species

29. Which group of vertebrates comprises the highest number of endangered species? *(2003)*
a. Mammals b. Fishes
c. Reptiles d. Birds

30. Number of wild life is continuously decreasing. What is the main reason of this? *(2002)*
a. Predation
b. Cutting down of forest
c. Destruction of habitat
d. Hunting

31. Occurrence of endemic species in South America and Australia due to: **[OS]***(2001)*
a. These species has been extinct from other regions
b. Continental separation
c. There is no terrestrial route to these places
d. Retrogressive evolution

32. *Lemur edri-edri* is found in: **[OS]***(2000)*
a. Madagascar b. Mauritius
c. India d. Sri Lanka

33. What shall be the effect of destruction of wild life? *(2000)*
a. Wild gene of disease resistance will not be obtained
b. Soil erosion
c. Floods
d. Greenhouse effect

34. Main reason of disturbance of biological diversity: *(1999)*
a. Greenhouse effect
b. Hunting
c. Soil erosion
d. Destruction of natural habitats

35. According to forestry commission report-*1997* the total forest cover of India: **[OS]***(1999)*
a. 11% b. 19.5%
c. 17% d. 18.7%

36. Recently extinct animal from India is: **[OS]***(1999)*
a. *Acinonyx* b. *Rhinoceros unicornis*
c. *Panthera leo* d. *Panthera tigris*

37. Reason for elimination of wild life is: *(1998)*
a. Deforestation b. Forest fire
c. Floods d. Less Rain fall

38. The breeding place of *Flamingo* (Hansawar) in India is most likely: **[OS]***(1996)*
a. Rann of Kutch b. Ghana Vihar
c. Sambhar lake d. Chilka lake

39. The most important human activity, leading to the extinction of wildlife is: *(1994)*
a. Pollution of air and water
b. Hunting for valuable wildlife products
c. Introduction of alien species
d. Alternation and destruction of the natural habitats

Biodiversity Conservation

40. The historic Convention on Biological Diversity, 'The Earth Summit' was held in Rio de Janeiro in the year: *(2023)*
a. 2002 b. 1992
c. 1985 d. 1986

41. The World Summit on sustainable development held in 2002 in Johannesburg, South Africa pledged for: *(2022 Re)*
a. Collection and preservation of seeds of different genetic strains of commercially important plants.
b. A significant reduction in the current rate of biodiversity loss.
c. Declaration of more biodiversity hotspots.
d. Increase in agricultural production.

42. Match List-I with List-II: **[MR*]** *(2022 Re)*

List-I		List-II	
(A)	Sacred groves	(I)	Alien species
(B)	Zoological park	(II)	Release of large quantity of oxygen
(C)	Nile perch	(III)	*Ex-situ* conservation
(D)	Amazon forest	(IV)	Khasi Hills in Meghalaya

Choose the correct answer from the options given below:
a. A-IV, B-III, C-II, D-I
b. A-IV, B-III, C-I, D-II
c. A-II, B-IV, C-I, D-III
d. A-IV, B-I, C-II, D-III

43. Western Ghats have a large number of plants and animal species that are not found anywhere else. Which of the following term is used to notify such species? *(2022 Re)*
a. Vulnerable species b. Threatened species
c. Keystone species d. Endemic species

44. Which of the following is not a method of *ex situ* conservation? *(2022)*
a. Cryopreservation b. *In vitro* fertilization
c. National Parks d. Micropropagation

45. *In-situ* conservation refers to: *(2022)*
a. Conserve only extinct species
b. Protect and conserve the whole ecosystem
c. Conserve only high risk species
d. Conserve only endangered species

46. In the following in each set a conservation approach and an example of method of conservation are given
A. *In situ* conservation - Biosphere Reserve
B. *Ex situ* conservation - Sacred groves
C. *In situ* conservation - Seed bank
C. *Ex situ* conservation - Cryopreservation
Select the option with correct match of approach and method. *(2020-Covid)*
a. A and D b. B and D
c. A and B d. A and C

47. Which one of the following is not a method of *in situ* conservation of biodiversity? *(2019)*
a. Biosphere Reserve b. Wildlife Sanctuary
c. Botanical Garden d. Sacred Grove

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48. The Earth Summit held in Rio de Janeiro in *1992* was called [MR^A] *(2019)*
a. To reduce CO_2 emissions and global warming
b. For conservation of biodiversity and sustainable utilization of its benefits
c. To assess threat posed to native species by invasive weed species
d. For immediate steps to discontinue use of CFCs that were damaging the ozone layer

49. All of the following are included in '*ex-situ* conservation' except: *(2018)*
a. Wildlife safari parks b. Sacred groves
c. Botanical gardens d. Seed banks

50. Which one of the following is related to *ex-situ* conservation of threatened animals and plants? *(2017-Delhi)*
a. Wildlife Safari parks b. Biodiversity hot spots
c. Amazon rainforest d. Himalayan region

51. The region of Biosphere Reserve which is legally protected and where no human activity is allowed is known as: *(2017-Delhi)*
a. Core zone b. Buffer zone
c. Transition zone d. Restoration zone

52. How many hot spots of biodiversity in the world have been identified till date by Norman Myers? *(2016 - II)*
a. 34 b. 43
c. 17 d. 25

53. Cryopreservation of gametes of threatened species in viable and fertile condition can be referred to as: *(2015)*
a. *In situ* conservation by sacred groves
b. *In situ* cryo-conservation of biodiversity
c. *In situ* conservation of biodiversity
d. Advanced *ex-situ* conservation of biodiversity

54. In which of the following both pairs have correct combination? [MR^A] *(2015)*
a. *In situ* conservation: Seed Bank
Ex situ conservation: National Park
b. *In situ* conservation: Tissue culture
Ex situ conservation: Sacred groves
c. *In situ* conservation: National Park
Ex situ conservation: Botanical Garden
d. *In situ* conservation: Cryopreservation
Ex situ conservation: Wildlife Sanctuary

55. The species confined to a particular region and not found elsewhere is termed as: *(2015 Re)*
a. Alien b. Endemic
c. Rare d. Keystone

56. An example of *ex situ* conservation is: *(2014)*
a. Sacred Grove b. National Park
c. Seed Bank d. Wildlife Sanctuary

57. Which one of the following is not used for *ex-situ* conservation? *(2013)*
a. Botanical Gardens b. Field gene banks
c. Seed banks d. Shifting cultivation

58. Which one of the following areas in India, is a hotspot of biodiversity? *(2012 Pre)*
a. Western Ghats b. Eastern Ghats
c. Gangetic Plain d. Sunderbans

59. Indian Rhinoceros is a natural inhabitant of which of the Indian states? [OS]*(2010 Mains)*
a. Himachal Pradesh b. Uttar Pradesh
c. Assam d. Uttarakhand

60. Chipko movement was launched for protection of: [OS]*(2009)*
a. Wetlands b. Forests
c. Grasslands d. Livestock

61. Tiger is not a resident in which of the following National Park? [OS]*(2009)*
a. Ranthambore b. Sunderbans
c. Gir d. Gim Corbett

62. Which one is not observed in biodiversity hotspot? *(2008)*
a. Less Interspecific competition
b. Species richness
c. Endemism
d. Accelerated species loss

63. World summit on sustainable development was held in: *(2008, 2002)*
a. South Africa b. Brazil
c. Argentina d. Sweden

64. Which one is odd combination of habitat and particular animal? [OS]*(2007)*
a. Sunderbans - Bengal Tiger
b. Periyar - Elephant
c. Rann of Kutch - Wild Ass
d. Dachigam National Park - Snow Leopard

65. Which one is correctly matched? [OS]*(2006)*
a. Rhinoceros - Kaziranga National Park
b. Great Indian Bustard - Keolado National Park
c. Lion - Corbett National Park
d. Wild Ass - Dudhwa National Park

66. Which one is a hotspot of biodiversity? *(2006)*
a. Aravalli hills b. Western Ghats
c. Indogangetic plain d. Eastern Ghats

67. Biodiversity act of India was passed by Parliament in: *(2005)*
a. 1992 b. 1996
c. 2000 d. 2002

68. An important function of botanical garden is: *(2005)*
a. Providing beautiful area for recreation
b. One can observe tropical plants over there
c. They allow *ex-situ* conservation of germplasm.
d. They provide natural habitat to wildlife.

69. In your opinion, which is the most effective way to conserve the plant diversity of an area? [MR^A] *(2004)*
a. By creating biosphere reserve
b. By creating botanical garden
c. By developing seed bank
d. By tissue culture method

70. What is a keystone species? *(2004)*
a. A common species that has plenty of biomass, yet has a fairly low impact on the community's organisation
b. A rare species that has minimal impact on the biomass and on other species in the community
c. A dominant species that constitutes a large proportion of the biomass and which affects many other species
d. A species which makes up only a small proportion of the total biomass of a community, yet has a huge impact on the community's organisation and survival

71. Viable material of endangered species can be preserved by: *(2000)*
a. Gene bank b. Gene library
c. Herbarium d. Gene pool

72. Best method to preserve the wild relatives of plants: *(1999)*
a. By growing them in natural habitats
b. Gene library
c. By storing seeds
d. Cryopreservation

73. Identify the correctly matched pair: [OS]*(1996)*

a. Corbett park	Aves
b. Rann of Kutch	Wild ass
c. Gir forest	Rhino
d. Kaziranga	Elephant

74. Identify the correct match between tiger reserve and its state: [OS]*(1995)*
a. Manas - Assam b. Corbett - Madhya Pradesh
c. Bandipur - Tamil nadu d. Palanau - Orissa

75. Which of the following is the matching pair of a sanctuary and its main protected wild animal? [OS]*(1995)*
a. Kaziranga-Musk deer b. Gir-Lion
c. Sunderban-Rhino d. All of these

Answer Key

1. (a)	2. (a)	3. (d)	4. (c)	5. (c)	6. (a)	7. (c)	8. (a)	9. (d)	10. (b)
11. (c)	12. (c)	13. (d)	14. (a)	15. (a)	16. (d)	17. (b)	18. (a)	19. (d)	20. (a)
21. (b)	22. (a)	23. (c)	24. (c)	25. (d)	26. (a)	27. (d)	28. (b)	29. (a)	30. (c)
31. (b)	32. (a)	33. (a)	34. (d)	35. (b)	36. (a)	37. (a)	38. (d)	39. (d)	40. (b)
41. (b)	42. (b)	43. (d)	44. (c)	45. (b)	46. (a)	47. (c)	48. (b)	49. (b)	50. (a)
51. (a)	52. (a)	53. (d)	54. (c)	55. (b)	56. (c)	57. (d)	58. (a)	59. (c)	60. (b)
61. (c)	62. (a)	63. (a)	64. (d)	65. (a)	66. (b)	67. (d)	68. (c)	69. (a)	70. (d)
71. (a)	72. (a)	73. (d)	74. (a)	75. (b)					

Explanations

1.(a) species within a genus

Paul Ehrlich's 'rivet popper hypothesis' illustrates the importance of biodiversity by comparing species within an ecosystem to rivets in an airplane.

2.(a) (b) > (a) > (c) > (e) > (d)

The tropical Amazonian rainforest in South America has the greatest biodiversity on Earth, with 40,000 species of plants, 3,000 of fishes, 1,300 of birds, 427 of mammals, 427 of amphibians, 378 of reptiles, and more than 1,25,000 invertebrates.

3. (d) Tropical environments are [illegible] or predictable. This ensures constant availability of fruits throughout the year for frugivorous birds.

4. (c) The largely tropical Amazonian rain forest in South America exhibits highest species biodiversity on earth.

5. (c) Robert May estimated global species diversity at about 7 million.

6. (a) Alexander von Humboldt observed that within a region species richness increased with increasing explored area, but only up to a limit.

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7. (c) According to the study of Alexander von Humboldt (German naturalist & geographer) in South American jungles, within a region, species richness increases with increasing explored area, but only up to a limit. Relation between species richness and area for a wide variety of taxa gives a rectangular hyperbola.
8. (a) A - Insects B - Mollusca
   C - Crustaceans D - Other animal group.
9. (d) The number of fungi species in the world is more than the combined total of the species of fishes, amphibians, reptiles and mammals
10. (b) The highest number of species in the world is represented ngi.

rthropods is the largest phylum of Animalia which includes insects. Over two-thirds of all named species on earth are arthropods.

12. (c) India has more than 50,000 genetically different strains of rice.
13. (d) In India, there are 1000 variety of mangoes and around 50,000 strains of rice.
14. (a) Area 's' has maximum species diversity, as there are 10 species (A - J) reside in 12 habitual, while in area 't' the 10 species reside in 13 habitats so, exhibits less diversity than area 's'.
15. (a) Tropical rain forests are richest in diversity as these forests are very dense and productive. Precipitation here is almost same in every season and thus very effective for good growth of plants species.
16. (d) Abundance of a species population in a habitat referred as niche density. Smaller the mean trait distances within species, greater is the niche density.
17. (b) There are four major causes of biodiversity losses (The Evil Quartet) that are habitat loss and fragmentation, over-exploitation, Alien species invasion and co-extinctions. Habitat loss and fragmentation is the most important cause driving animals and plants to extinction.
18. (a) Over-exploitation, habitat loss and fragmentation.

    Biodiversity loss is primarily caused by over-exploitation of species, habitat loss and fragmentation.
19. (d) The main four reasons of biodiversity loss are habitat loss and fragmentation, over-exploitation, alien species invasion and co-extinction. 'The Evil Quartet' is the sobriquet used to describe them.

    Natality refers to the number of births during a given period in the population that are added to the initial density.

Competition is a biological interaction between two or more organisms of the same or different species where the species compete with each other for different resources.

The rapid increase in human population over a relatively short period of time is called population explosion.

20. (a) Habitat loss and fragmentation is the most important cause driving animals and plants to extinction. Eg: Loss of tropical rainforest reducing the forest cover from 14 % to 6 %.
21. (a) The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years.
22. (a) Invasive weed species like carrot grass (*Parthenium*), *Lantana* and water hyacinth (*Eichhornia*) threat posed to our native species.
23. (c) Habitat loss and fragmentation is the most important cause driving animals and plants to extinction. The most dramatic examples of habitat loss come from tropical rain forests.
24. (c) IUCN publishes the Red list of species.
25. (d) According to IUCN, species facing high risk of extinction in immediate future are considered as critically endangered.
26. (a) A species of organism that is not native to a locality and having been moved there from its natural range by humans or other agents is called exotic species.

    E.g., *Lantana camara*, Water hyacinth.
27. (d) According to IUCN, endangered species is species of plants or animals which is being in immediate danger of extinction.

    E.g., Bentinckia nicobarica (Asteraceae family) and Red panda.
28. (b) Red panda is an endangered species because it is facing a very high risk of extinction in near future.
29. (a) The endangered species listed in Red Book mostly belongs to class Mammalia.
30. (c) Habitat loss is the greatest threat to variety of life on this planet. It is identified as a main threat to 85% of all species described in IUCN's Red List of threatened and endangered species.
31. (b) South America & Australia are separated continents, surrounded by oceans. Due to this, rate of migration across these countries is very less and therefore, endemic species are found here.
32. (a) All species of Lemurs are endemic to Madagascar island.
33. (a) Destruction of wildlife is very harmful for the planet as wildlife is a source of many benefits to the ecosystem & survival of mankind. So, if an wild life destruction takes place, wild gene of disease resistance will not be obtained.
34. (d) Loss of natural habitats is a major threat for disturbance of biodiversity.
35. (b) Total forest cover of India in 1997 was 19.5% of the country's geographical area. In next decade (1997-2007), the percent has been increased to 23.84% of forest cover in India.

...ol *Acinonyx* is cheetah, ... endangered and is surviving today only in Iran.

...d) Deforestation is the main anthropogenic activity, causing harm to our planet and all the lives on this planet. With increasing human population, rate of deforestation is also rapidly increasing and destructing many kinds of habitats.

...d) Chilka's lake in Orissa is one of the India's migratory birds paradise. It is an important habitat and breeding ground of flamingo in India.

...d) Loss of habitats is a major problem to deal with, in order to conserve biodiversity. Habitat loss is making the wildlife homeless and vulnerable to extinction.

...b) The historic Convention on Biological Diversity ('The Earth Summit') held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

...b) The World Summit on Sustainable Development held in 2002 in Johannesburg, South Africa, pledged for a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

...(b)

A. Sacred groves - (IV) Khasi Hill's in Meghalaya

B. Zoological park - (III) *Ex-situ* conservation

C. Nile perch - (I) Alien species

D. Amazon forest - (II) Release of large quantity of oxygen

...(d) Species that are found only in a particular area and nowhere else are termed endemic. The Western Ghats have a large number of plants and animal species that are endemic.

...(c) *Ex situ* conservation is an approach to conserve endangered or threatened animals or plants. These organisms face a very high risk of extinction in the wild in the near future and needs urgent measure to save it from extinction. It includes cryopreservation, in vitro fertilization, micropropagation. Zoological parks, botanical gardens and wildlife safari parks also serve this purpose.

In situ (on site) conservation is an approach to conserve and protect the whole ecosystem. It includes biosphere reserves, national parks and sanctuaries.

...(b) *In situ* (on site) conservation is an approach to conserve and protect the whole ecosystem. It includes biosphere reserves, national parks and sanctuaries.

...(a) *Ex-situ* conservation is done by preserving the components of biological diversity outside their natural habitats. It is done by conserving genetic resources, as well as wild and cultivated or species. Examples: cryopreservation, gene bank, zoological parks, botanical gardens and wildlife safari parks

In situ conservation is done by conserving the species in their natural habitats. It is the best way of biodiversity conservation. Examples: sacred grooves, biosphere reserves, national parks and sanctuaries.

...159

47. (c) Botanical garden is a method of *ex - situ* conservation (off-site conservation), i.e., living plants (flora) are conserved in human managed system.
48. (b) The Earth Summit held in Rio de Janeiro in *1992*, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.
49. (b) Sacred groves are forest fragments of varying sizes which are communally protected. It is an example of *in-situ* conservation.
50. (a) *Ex-situ* conservation includes zoological parks, botanical gardens and wildlife safari parks to serve special care and protection to threatened plants and animals.
51. (a) Biosphere reserve is protected area with multipurpose activities.

    It has three zones:

    (a) Core zone – without any human interference

    (b) Buffer zone – with limited human activity

    (c) Transition zone – human settlement, grazing cultivation etc., are allowed.
52. (a) Initially 25 biodiversity hotspots were identified but subsequently 9 more have been added to the list, bringing the total number of biodiversity hotspots in the world to 34.
53. (d) In recent years, *ex-situ* conservation has advanced beyond keeping threatened species in enclosures. Gametes of threatened species can be preserved using cryopreservation techniques.
54. (c) *In situ* conservation - hotspot, biosphere reserves, national parks, sanctuary; *Ex situ* - Zoological parks, Botanical gardens and wildlife safari parks, seed banks, etc.
55. (b) The species which is found in a particular natural habitat beyond which it is unknown is called endemic species.
56. (c) *Ex-situ*: Zoological park, Botanical gardens and seed banks
57. (d) Shifting cultivation results into deforestation.
58. (a) Three of these hotspots – Western Ghats and Sri Lanka, Indo-Burma and Himalaya – cover our country's exceptionally high biodiversity regions.
59. (c) Indian rhinoceros is a natural inhabitant of Assam in India. It is now protected in Kaziranga National Park.
60. (b) Chipko movement of Garhwal Himalayas started in 1974 by the local tribe to protect forest.
61. (c) Gir National Park (Gujarat) is not concerned with tiger. The animals found in Gir National Park are Asiatic Lion, Panther, Stripped hyaena, Sambar nilgai, Chital, 4-horned Antelope and Chinkara. While rest three are tiger reserves.
62. (a) Hotspots are rich in biodiversity, have high endemism and are under threat of extinction.
63. (a) The world summit on sustainable development held in 2002. In Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010.
64. (d) Dachigam National Park is situated near Dal Lake in Jammu and Kashmir. It is famous for most endangered Hangul or Kashmir stag.

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65. **(a)** Rhinoceros is an endangered animal and conserved in Kaziranga National Park.

66. **(b)** Biodiversity Hotspots: These are the regions with very high levels of species richness and high degree of endemism. E.g., Western Ghats and Sri-lanka, Indo-Burma and Himalaya.

67. **(d)** Biological diversity; variety among living organisms and the ecological complexes in which they occur. In India, Biodiversity act of India passed by the Parliament in the year 2002.

68. **(c)** Botanical gardens are comes under approach of ex-situ conservation of germplasms.

69. **(a)** Biosphere reserves are representative parts of natural & cultural landscapes extending over large area of an ecosystem to protect and conserve the natural habitat.

70. **(d)** Removal of keystone species alter the habitat and ecosystem around them and thus affect large numbers of other organisms. They play a crucial role in the way an ecosystem functions.

71. **(a)** Gene bank preserve genetic material in viable forms (e.g. seeds in plants & gametes in animals). Mostly endangered species are preserved like this.

72. **(a)** Wild species are most protective and preserved in their natural habitats. By conserving these habitats, we can preserve plant species of wildlife.

73. **(d)** Kaziranga National Park is famous for one-horned rhinoceros of India. Other animals found are elephant, wild buffalo, bison, tiger, leopard, sloth bear, etc. Corbett National Park is famous for tigers. Gir National Park is famous for the asiatic lions. Rann of Kutch is famous for chinkara.

74. **(a)** Manas biosphere reserve is located in Assam. To save tiger from extinction, 'Project Tiger' was launched in our country in 1972.

75. **(b)** Gir sanctuary is a dense forest of 70 km length and 45 km width, situated in Gujarat, and is famous for asiatic lion.

TEAM Kohinoor

New NEET Essentials

Morphology of Flowering Plants
(Malvaceae, Cruciferae, Compositae and Gramineae)

1. Which of the following shows the floral characteristic of Cruciferae?
   a. Six tepals, zygomorphic, six stamens, bilocular ovary, axile placentation.
   b. Hermaphrodite, actinomorphic, tetradynamous, hypogynous, bicarpellary, bilocular (replum), placentation parietal.
   c. Bisexual, actinomorphic, six stamens, polyandrous, superior ovary, axile placentation.
   d. Three tepals, bisexual, zygomorphic, gamophyllous, inferior ovary, marginal placentation.

2. **Assertion:** In the Gramineae family, the two bracts are palea and lemma enclose flower.
   Reason: In the Gramineae family, the gynoecium is tricarpellary with inferior ovary.
   a. Both Assertion and Reason are True, and the Reason is a correct explanation of the Assertion.
   b. Both Assertion and Reason are True, but Reason is not a correct explanation of the Assertion.
   c. Assertion is True, but the Reason is False.
   d. Assertion is False, but the Reason is True.

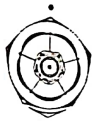
3. Complete the floral formula of the family Malvaceae.

   $Br\,\oplus\,\varphi\,Epi\,\square K\,\square\,\overset{(ii)}{C}\,\square\,\overset{(iii)}{\hat{A}}\,\square\,\underset{(iv)}{G_{(5-\infty)}}$

   a. (i) – 3, (ii) – 5, (iii) – 5, (iv) – 3
   b. (i) – 3 – 7, (ii) –(5), (iii) – 5, (iv) –(∞)
   c. (i) – 3 – 5, (ii) –3, (iii) –(5), (iv) –(2 – ∞)
   d. (i) – 3, (ii) – 5, (iii) –(3), (iv) – 2

4. Which family exhibits actinomorphic, pedicellate, bisexual, complete, pentamerous flowers, typically protected by an epicalyx?
   a. Malvaceae
   b. Cruciferae
   c. Compositae
   d. Gramineae

5. Identify the correct statement about the diagram.



   a. The flower of this family consists of a capitulum or head.
   b. The flower of this family consists of a free anther but fused filaments.
   c. The flower of this family lacks pappus.
   d. The flower of this family consists gynoecium of bilocular basal placentation.

6. Identify the plant family from the floral diagram given below.

   a. Malvaceae
   b. Cruciferae
   c. Gramineae
   d. Leguminosae

7. Mark the following statements as true (T) or false (F) and select the correct option.
   I. In mustard, filaments of stamens are of similar lengths.
   II. In Cruciferae, the outer two stamens are short, and the inner four stamens are long.
   III. The fruit of the china rose is a capsule.
   IV. Marigold, sunflower, and *Chrysanthemum* are members of the family Malvaceae.

	I	II	III	IV
(a)	False	True	True	False
(b)	True	False	True	False
(c)	False	False	False	True
(d)	True	True	False	True

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8. Statement-I: In the Asteraceae family within the capitulum, there are ray florets at the center, surrounded by disc florets.
Statement-II: Disc Florets are present in the centre of the head, bracteate, bisexual, actinomorphic, tubular, pentamerous.

a. Both Statement-I and Statement-II are correct.
b. Both Statement-I and Statement-II are incorrect.
c. Statement-I is correct & Statement-II is incorrect.
d. Statement-I is incorrect & Statement-II is correct.

9. Match the characteristics to the correct plants:

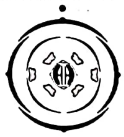
	Characteristics	Plant
P	Zygomorphic, bisexual flowers with basal placentation.	Sunflower
Q	Actinomorphic, pentamerous, bisexual flowers protected by epicalyx.	China rose
		Okra
		Wheat

a. P- Okra ; Q- Sunflower b. P- Wheat; Q- China rose
c. P- China rose; Q- Okra d. P- Sunflower, Q- China rose

10. What distinct feature allows the immediate identification of the Brassicaceae family?

a. Inferior ovary and cruciform corolla
b. Tetradynamous stamens and replum
c. Tetradynamous stamens and axile placentation
d. Cruciform corolla and indehiscent fruit

11. Choose the correct floral formula for the given diagram.



a. $\oplus\ \delta\ K_{2+2}\ C_4\ A_{2+4}\ \underline{G}_{(2)}$ b. $\%\ \delta\ K_{(5)}\ C_{1+2+(2)}\ A_{9+1}\ \underline{G}_1$
c. $\oplus\ \delta\ K_{(5)}\ \widehat{C_{(5)}\ A_{(5)}}\ \underline{G}_{(2)}$ d. $Br\oplus\ \delta\ P_{(3+3)}\ \widehat{A_{3+3}}\ \underline{G}_{(3)}$

12. Familiar example of family Compositae is

a. *Helianthus annuus, Artemisia annua, Tagetes erecta*
b. *Pennisetum typhoideum, Bambusa*, and *Atropa belladonna*
c. *Allium cepa, Saccharum officinarum*, and *Aloe vera*
d. *Allium cepa, Pennisetum typhoideum* and *Solanum nigrum*

13. Which of the following plants also show similar inflorescence as shown in the given image?

a. *Indigofera, Sesbania, Brassica rapa*, Sunhemp
b. *Ashwagandha, Petunia, Sesbania, Colchicum autumnale*
c. *Indigofera, Ashwagandha*, Sunhemp, *Trifolium*
d. *Trifolium, Petunia, Brassica rapa, Colchicum autumnale*

14. Which of the following plant is bisexual, syncarpous, superior ovary, actinomorphic, parietal placentation, tap root system, variation in the length of filaments within a flower?

a. Mustard b. Sweet pea
c. Soyabean d. Moong

15. Which of the following statements is correct about the given image?

a. The image shows the fruit of the Leguminosae family.
b. The image shows the fruit of the *Hibiscus* or mallow family.
c. The image shows the fruit of the sunflower family.
d. The image shows the fruit of the mustard family.

Human Health and Diseases
(Tobacco Abuse, Dengue and Chikungunya)

1. The diseases transmitted through insects like mosquitoes can be controlled by introducing fish like
(a) *Labeo* (b) *Gambusia*
(c) *Hilsa* (d) *Eelpout*

2. Smoking increases _____(P)_____ content in blood and reduces the concentration of _____(Q)_____ oxygen.
(a) P-Carbon monoxide (CO), Q- Haembound
(b) P- Carbon dioxide, Q- Free
(c) P-Nicotine, Q- Bound
(d) P-Carbon monoxide, Q- Molecular

3. *Flavivirus* causes
(a) Malaria (b) Chicken pox
(c) Common cold (d) Dengue

4. Read the given statements and choose the correct option.
Statement-I: Frequent use of psychologists, psychiatrists, and de-addiction and rehabilitation programs can be costly and unnecessary.
Statement-II: It's important to encourage students to perform their best and always push them excessively to outperform their peers.
(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

5. Assertion: People consuming tobacco are more likely to develop cardiovascular diseases.
Reason: Nicotine, an alkaloid present in tobacco, stimulates the adrenal glands to release adrenaline and nor-adrenaline into the bloodstream, leading to increased blood pressure and heart rate.
(a) Both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.
(b) Both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.
(c) Assertion is True but the Reason is False.
(d) Assertion is False but the Reason is True.

6. Match column-I with column-II and select the correct option

	Column I		Column II
A.	Dengue	(i)	*Aedes aegypti*
B.	Chikungunya	(ii)	High fever and severe joint pain
		(iii)	*Anopheles* mosquito
		(iv)	Eliminating stagnant water
		(v)	*Flavivirus*

(a) A-(i), (iv); B-(iv), (v)
(b) A-(i), (ii), (iv), (v); B-(i), (ii), (iv)
(c) A-(ii), (iv), (v); B-(i), (v)
(d) A-(ii), (iii), (v); B-(i), (iv)

7. Dengue fever is transmitted by
(a) *Anopheles* mosquito (b) *Culex* mosquito
(c) *Aedes* mosquito (d) Tsetse fly

8. Which plant is the source of tobacco?
(a) *Diospyros melanoxylon*
(b) *Nicotiana tabacum*
(c) *Erythroxylum coca*
(d) *Papaver somniferum*

9. Along with nicotine, cigarette smokers receive tars, phenols, hydrocarbons, arsenic, and many other chemicals. Which of the following is not an effect of smoking tobacco?
(a) Risk of cardiovascular diseases
(b) Irritation of the mucous membrane of the throat
(c) Reduction in the surface for gas exchange
(d) None of these

10. Which of the following statements regarding Dengue and Chikungunya is incorrect?
(a) Dengue and Chikungunya are both viral diseases caused by viruses.
(b) The primary mode of transmission for both Dengue and Chikungunya is through the bite of *Anopheles* mosquitoes.
(c) Common symptoms of both Dengue and Chikungunya infections include high fever and severe joint pain.
(d) To prevent the spread of these diseases, it is essential to discourage mosquito breeding.

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Biotechnology and its Applications
(Tissue culture)

1.

Statement-I: Totipotency is an artificially induced phenomenon.

Statement-II: The mammalian gametes is also known to possess totipotent traits.

(a) Both Statement-I and Statement-II are correct.
(b) Both Statement-I and Statement-II are incorrect.
(c) Statement-I is correct & Statement-II is incorrect.
(d) Statement-I is incorrect & Statement-II is correct.

2. **Assertion:** Tissue culture involves growing plant parts under non-sterile conditions in nutrient media.

Reason: Explants refer to any part of a plant taken out and grown in a test tube under sterile conditions in special nutrient media.

(a) Both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.
(b) Both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.
(c) Assertion is True but the Reason is False.
(d) Assertion is False but the Reason is True.

3. Somatic hybridization is achieved by which of the following processes:
(a) Fusion of two protoplasts from the same species
(b) Fusion of two protoplasts from different species
(c) Inducing chromosome doubling in androgenic cultures
(d) Fusion of two protoplasts from sperm and egg

4. Which of the following is not added in nutrient medium?
(a) Sucrose (b) Vitamins
(c) Protease (d) Cytokinins and auxin

Under which condition do somaclones development takes place?
(a) Plants subjected to tissue culture.
(b) Plants irradiated with gamma rays.
(c) Plants thriving in contaminated soil or water.
(d) Plants modified through recombinant DNA technology.

6. If a plant infected with a virus needs to recover as a healthy plant through tissue culture, which cells of the plant will be utilized for the culture?
(a) Apical meristematic cells.
(b) Axillary meristematic cells.
(c) Cells from any part of the plant.
(d) Both (a) and (b)

7. The term for the capacity of individual cells to divide and give rise to all specialized cells in an organism:
(a) Totipotency (b) Multipotency
(c) Unipotency (d) Polypotency

8. In which group is the property of cellular totipotency commonly found?
(a) Plants (b) Viruses
(c) Protista (d) *Amoeba*

9. Method of producing thousands of plants through tissue culture is called _____.
(a) Micropropagation (b) Tissue propagation
(c) Somatic propagation (d) Somatic hybridisation

10. Match the Column-I with Column-II and choose the correct option:

	Column-I		Column-II
I.	Totipotency	A.	Plants genetically identical to the original plants
II.	Micropropagation	B.	Plant grown from hybrid protoplast
III.	Somaclone	C.	Producing a large number of plants
IV.	Somatic hybrid	D.	Capacity to generate a whole plant from an explant

(a) I-D II-C, III-B, IV-A (b) I-A, II-C, III-B, IV-D
(c) I-C, II-B, III-A, IV-D (d) I-D, II-C, III-A, IV-B

Answer Key

Morphology of Flowering Plants

1. (b)	2. (c)	3. (b)	4. (a)	5. (a)	6. (c)	7. (a)	8. (d)	9. (b)	10. (b)
11. (a)	12. (a)	13. (a)	14. (a)	15. (d)					

Human Health and Diseases

1. (b)	2. (a)	3. (d)	4. (c)	5. (a)	6. (b)	7. (c)	8. (b)	9. (d)	10. (b)

Biotechnology and its Applications

1. (b)	2. (d)	3. (b)	4. (c)	5. (a)	6. (d)	7. (a)			

Explanations

Morphology of Flowering Plants

1. (b) The floral characters of family Cruciferae are hermaphrodite, actinomorphic, tetrudynamous, hypogynous, bicarpellary, bilocular (replum), placentation parietal.

2. (c) In Gramineae, two bracts palea and lemma enclose flower or floret. The gynoecium is monocarpellary with superior unilocular ovary.

3. (b) The floral formula of the family Malvaceae is

$$Br \oplus \delta \; Epi_{3-7}\, K_{(5)}\, \overbrace{C_{(5)}\, A_{(\infty)}}\, \underline{G}_{(3-\infty)}$$

4. (a) Malvaceae exhibits actinomorphic, pedicellate, bisexual, complete, pentamerous flowers, typically protected by an epicalyx.

5. (a) The floral diagram depicts the Compositae family, characterized by flowers that have a capitulum or head, which may be terminal or axillary, and are surrounded by bracts.

6. (c) The given floral diagram represents the family Gramineae.

7. (a) In mustard, filaments of stamens are of variable lengths and Marigold, sunflower, and *Chrysanthemum* are members of the family Asteraceae.

8. (d) In the Asteraceae family within the capitulum, there are disc florets at the center, surrounded by ray florets. Disc florets are present in the centre of the head, bracteate, bisexual, actinomorphic, tubular, pentamerous.

9. (b) P with zygomorphic, bisexual flowers and basal placentation matches Wheat, while Q with actinomorphic, pentamerous, bisexual flowers and an epicalyx matches China rose.

10. (b) The Brassicaceae family can be identified by tetradynamous stamens (four long, two short) and the gynoecium being unilocular, becomes bilocular due to a false septum known as the replum.

11. (a) The given floral diagram represents the Brassicaceae family which is represented by $\oplus \; \delta \; K_{2+2}\, C_4\, A_{2+4}\, \underline{G}_{(2)}$.

12. (a) *Helianthus annuus, Artemisia annua, Tagetes erecta.*

13. (a) Among the given options, *Brassica rapa* belongs to Cruciferae, and *Indigofera*, Sesbania, and Sunhemp belong to Fabaceae, as they exhibit racemose inflorescence, a characteristic feature of these families.

14. (a) Mustard

15. (d) The image shows the siliqua fruit which is the characteristic feature of family Cruciferae.

Human Health and Diseases

1. (b) Introducing *Gambusia* fish into ponds, which feed on mosquito larvae, is an effective method for controlling diseases transmitted by mosquitoes like dengue and chikungunya.

2. (a) Smoking increases carbon monoxide (CO) content in blood and reduces the concentration of haembound oxygen.

3. (d) *Flavivirus* causes dengue.

4. (c) The frequent use of psychologists, psychiatrists, and be costly and may not always be necessary for every individual. Excessive pressure and the constant push to outperform peers can lead to stress and mental health issues in students. It's important to encourage students to do their best but not at the cost of their well-being.

5. (a) Nicotine found in tobacco stimulates the adrenal glands, causing the release of adrenaline and nor-adrenaline into the bloodstream, leading to elevated blood pressure and heart rate. This usage of tobacco is strongly linked to an increased risk of various health issues, including cardiovascular diseases, lung, urinary bladder, and throat cancers, bronchitis, etc.

6. (b) Both Dengue and Chikungunya are transmitted by the *Aedes aegypti* mosquito, resulting in high fever and severe joint pain. Prevention includes eliminating stagnant water. Dengue is caused by the *Flavi virus*, while Chikungunya is caused by the *Chikungunya virus*.

7. (c) Dengue fever is spread by the *Aedes* mosquito

8. (b) Tobacco is obtained from *Nicotiana tabacum*.

9. (d) All the mentioned effects are associated with smoking tobacco. Smoking tobacco is known to increase the risk of cardiovascular diseases, irritate the mucous membrane of the throat, and reduce the surface area for gas exchange in the lungs.

10. (b) The primary mode of transmission for both Dengue and Chikungunya is through the bite of *Aedes* mosquitoes.

Biotechnology and its Applications

1. (b) Totipotency is a natural property of certain cells, not artificially induced. Mammalian gametes do not possess totipotent traits; it is the zygote formed after fertilization that is totipotent.

2. (d) Tissue culture involves the regeneration of entire plants from explants, which are any plant parts removed and grown in a controlled, sterile environment within special nutrient media in test tubes.

3. (b) Somatic hybridization is achieved through fusion of two protoplasts from different species, facilitating genetic material exchange and hybrid creation.

4. (c) Protease is not typically added to the nutrient medium in tissue culture. This enzyme is used to break down proteins and is not a standard component of plant tissue culture media.

5. (a) Plants subjected to tissue culture will give rise to genetic similar plants i.e., somaclones.

6. (d) Both virus-free apical and axillary meristematic cells are viable options for tissue culture to regenerate a healthy plant from a virus-infected one, as they are totipotent.

7. (a) The ability of single cells to divide and produce all differentiated cells in an organism is called totipotency.

8. (a) Plants

9. (a) Method of producing thousands of plants through tissue culture is called micropropagation.

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2024
NEET Solved Paper

Year 2024 NEET Solved Paper

Botany

Section-A

Biological Classification

(Kingdom Fungi)

1. Which one of the following is not a criterion for classification of fungi?
   a. Mode of spore formation
   b. Fruiting body
   c. Morphology of mycelium
   d. Mode of nutrition

2. Match List-I with List-II.

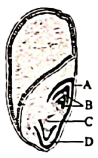
	List-I		List-II
(A)	*Rhizopus*	(I)	Mushroom
(B)	*Ustilago*	(II)	Smut fungus
(C)	*Puccinia*	(III)	Bread mould
(D)	*Agaricus*	(IV)	Rust fungus

Choose the correct answer from the options given below:
   a. A-(III), B-(II), C-(I), D-(IV)
   b. A-(IV), B-(III), C-(II), D-(I)
   c. A-(III), B-(II), C-(IV), D-(I)
   d. A-(I), B-(III), C-(II), D-(IV)

Morphology of Flowering Plants

(The Seed)

3. Identify the part of the seed from the given figure which is destined to form root when the seed germinates.



   a. C
   b. D
   c. A
   d. B

(The Flower)

4. Identify the type of flowers based on the position of calyx, corolla and androecium with respect to the ovary from the given figures (A) and (B).

   a. (A) Perigynous; (B) Epigynous
   b. (A) Perigynous; (B) Perigynous
   c. (A) Epigynous; (B) Hypogynous
   d. (A) Hypogynous; (B) Epigynous

5. Which of the following is an example of actinomorphic flower?
   a. *Pisum*
   b. *Sesbania*
   c. *Datura*
   d. *Cassia*

Anatomy of Flowering Plants

(Anatomy of Dicot & Monocot Plants)

6. Bulliform cells are responsible for
   a. Increased photosynthesis in monocots.
   b. Providing large spaces for storage of sugars.
   c. Inward curling of leaves in monocots.
   d. Protecting the plant from salt stress.

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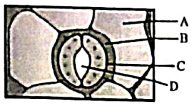
(Tissue System)

7. In the given figure, which component has thin outer walls and highly thickened inner walls?



a. A
b. B
c. C
d. D

(Permanent Tissues)

8. Given below are two statements:

Statement I: Parenchyma is living but collenchyma is dead tissue.

Statement II: Gymnosperms lack xylem vessels but presence of xylem vessels is the characteristic of angiosperms.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is true put Statement II is false
b. Statement I is false but Statement II is true
c. Both Statement I and Statement II are true
d. Both Statement I and Statement II are false

Cell The Unit of Life

(Nucleus and Microbodies)

9. Match List-I with List-II.

List-I		List-II	
(A)	Nucleolus	(I)	Site of formation of glycolipid
(B)	Centriole	(II)	Organization like the cartwheel
(C)	Leucoplasts	(III)	Site for active ribosomal RNA synthesis
(D)	Golgi apparatus	(IV)	For storing nutrients

Choose the correct answer from the options given below:

a. A-(III), B-(IV), C-(II), D-(I)
b. A-(I), B-(II), C-(III), D-(IV)
c. A-(III), B-(II), C-(IV), D-(I)
d. A-(II), B-(III), C-(I), D-(IV)

Biomolecules

(Enzymes)

10. Inhibition of Succinic dehydrogenase enzyme by malonate is a classical example of:

a. Competitive inhibition
b. Enzyme activation
c. Cofactor inhibition
d. Feedback inhibition

11. The cofactor of the enzyme carboxypeptidase is

a. Flavin
b. Haem
c. Zinc
d. Niacin

(Analysis of Chemical Composition)

12. Lecithin, a small molecular weight organic compound found in living tissues, is an example of:

a. Glycerides
b. Carbohydrates
c. Amino acids
d. Phospholipids

Cell Cycle and Cell Division

(Mitosis)

13. Spindle fibers attach to kinetochores of chromosomes during

a. Anaphase
b. Telophase
c. Prophase
d. Metaphase

(Meiosis)

14. Given below are two statements:

Statement I: Chromosomes become gradually visible under light microscope during leptotene stage.

Statement II: The beginning of diplotene stage is recognized by dissolution of synaptonemal complex.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is true but Statement II is false
b. Statement I is false but Statement II is true
c. Both Statement I and Statement II are true
d. Both Statement I and Statement II are false

Photosynthesis in Higher Plants

(Where are ATP & NADPH Used?)

15. Which of the following are required for the dark reaction of photosynthesis?

A. Light
B. Chlorophyll
C. CO_2
D. ATP
E. NADPH

Choose the correct answer from the options given below:

a. C, D and E only
b. D and E only
c. A, B and C only
d. B, C and D only

16. How many molecules of ATP and NADPH are required for every molecule of CO_2 fixed in the Calvin cycle?

a. 3 molecules of ATP and 3 molecules of NADPH
b. 3 molecules of ATP and 2 molecules of NADPH
c. 2 molecules of ATP and 3 molecules of NADPH
d. 2 molecules of ATP and 2 molecules of NADPH

Plant Growth and Development

(Differentiation, Dedifferentiation, Redifferentiation and Development)

17. Formation of interfascicular cambium from fully developed parenchyma cells is an example for

a. Dedifferentiation
b. Maturation

(Plant Growth Regulators)

18. Auxin is used by gardeners to prepare weed free lawns. But no damage is caused to grass as auxin

a. does not affect mature monocotyledonous plants.
b. can help in cell division in grasses, to produce growth.
c. promotes apical dominance.
d. promotes abscission of mature leaves only.

Sexual Reproduction in Flowering Plants

(Flowering and Pre-fertilisation)

19. Identify the set of correct statements:

A. The flowers of *Vallisneria* are colourful and produce nectar.
B. The flowers of waterlily are not pollinated by water.
C. In most of water-pollinated species, the pollen grains are protected from wetting.
D. Pollen grains of some hydrophytes are long and ribbon like.
E. In some hydrophytes, the pollen grains are carried passively inside water.

Choose the correct answer from the options given below:

a. A, C, D and E only
b. B, C, D and E only
c. C, D and E only
d. A, B, C and D only

Principles of Inheritance and Variation

(Mendal's Laws of Inheritance And Inheritance of One Gene)

10. In a plant, black seed color (BB/Bb) is dominant over white seed color (bb). In order to find out the genotype of the black seed plant, with which of the following genotype will you cross it?

a. Bb
b. BB/Bb
c. BB
d. bb

11. A pink flowered Snapdragon plant was crossed with a red flowered Snapdragon plant. What type of phenotype/s is/are expected in the progeny?

a. Only pink flowered plants
b. Red, Pink as well as white flowered plants
c. Only red flowered plants
d. Red flowered as well as pink flowered plants

12. Match List-I with List-II.

List-I		List-II	
(A)	Two or more alternative forms of a gene	(I)	Back cross
(B)	Cross of F_1 progeny with homozygous recessive parent	(II)	Ploidy
(C)	Cross of F_1 progeny with any of the parents	(III)	Allele
(D)	Number of chromosome	(IV)	Test cross

Choose the correct answer from the options given below

a. A-(III), B-(IV), C-(I), D-(II)
b. A-(IV), B-(III), C-(III), D-(I)
c. A-(I), B-(II), C-III, D (IV)
d. A-(II), B-(I), C-(III), D-(IV)

23. Which one of the following can be explained on the basis of Mendel's Law of Dominance?

A. Out of one pair of factors one is dominant and the other is recessive.
B. Alleles do not show any expression and both the characters appears as such in F_1 generation.
C. Factors occur in pairs in normal diploid plants
D. The discrete unit controlling a particular character is called factor.
E. The expression of only one of the parental characters is found in a monohybrid cross.

Choose the correct answer from the options given below:

a. B, C and D only
b. A, B, C, D and E
c. A, B and C only
d. A, C, D and E only

Molecular Basis of Inheritance

(Transcription)

24. A transcription unit in DNA is defined primarily by the three regions in DNA and these are with respect to upstream and down stream end;

a. Inducer, Repressor, Structural gene
b. Promotor, Structural gene, Terminator
c. Repressor, Operator gene, Structural gene
d. Structural gene, Transposons, Operater gene

(Regulation of Gene Expression)

25. The lactose present in the growth medium of bacteria is transported to the cell by the action of

a. Permease
b. Polymerase
c. Beta-galactosidase
d. Acetylase

Microbes in Human Welfare

(Microbes in Household & Industrial Products)

26. Match List-I with List-II.

List-I		List-II	
(A)	*Clostridium butylicum*	(I)	Ethanol
(B)	*Saccharomyces cerevisiae*	(II)	Streptokinase
(C)	*Trichoderma polysporum*	(III)	Butyric acid
(D)	*Streptococcus* sp.	(IV)	Cyclosporin-A

Choose the correct answer from the options given below:

a. A-(III), B-(I), C-(IV), D-(II)
b. A-(IV), B-(I), C-(III), D-(II)
c. A-(III), B-(I), C-(II), D-(IV)

Biotechnology : Principles and Processes

(Tools of Recombinant DNA Technology)

27. *Hind* II always cuts DNA molecules at a particular point called recognition sequence and it consists of:

a. 4 bp
b. 10 bp
c. 8 bp
d. 6 bp

(Principles of Biotechnology)

28. What is the fate of a piece of DNA carrying a gene of interest which is transferred into an alien organism?

A. The piece of DNA would be able to multiply, itself independently in the progeny cells of the organism.
B. It may get integrated into the genome of recipient.
C. It may multiply and be inherited along with the host DNA.
D. The alien piece of DNA is not an integral part of chromosome.
E. It shows ability to replicate.

Choose the correct answer from the options given below:

a. B and C only
b. A and E only
c. A and B only
d. D and E only

Biotechnology and Its Applications

(Biotechnological Applications In Agriculture)

29. The capacity to generate a whole plant from any cell of the plant is called:

a. Differentiation
b. Somatic hybridization
c. Totipotency
d. Micropropagation

30. Given below are two statements:

Statement I: Bt toxins are insect group specific and coded by a gene *cry IAc*.

Statement II: Bt toxin exists as inactive protoxin in *B. thuringiensis*. However, after ingestion by the insect the inactive protoxin gets converted into active form due to acidic pH of the insect gut.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is true but Statement II is false
b. Statement I is false but Statement II is true
c. Both Statement I and statement II are true
d. Both Statement I and Statement II are false

Organisms and Populations

(Population Attributes, Population Growth and Life History Variation)

31. The equation of Verhulst-Pearl logistic growth is $\frac{dN}{dt} = rN\left[\frac{K-N}{K}\right]$.

From this equation, K indicates:

a. Carrying capacity
b. Population density
c. Intrinsic rate of natural increase
d. Biotic potential

Biodiversity and Conservation

(Biodiversity Conservation)

32. The type of conservation in which the threatened species are taken out from their natural habitat and placed in special setting where they can be protected and given special care is called;

a. Semi-conservative method
b. Sustainable development
c. *in-situ* conservation
d. Biodiversity conservation

(Biodiversity & Patterns of Biodiversity)

33. Tropical regions show greatest level of species richness because

A. Tropical latitudes have remained relatively undisturbed for millions of years, hence more time was available for species diversification.
B. Tropical environments are more seasonal.
C. More solar energy is available in tropics.
D. Constant environments promote niche specialization.
E. Tropical environments are constant and predictable.

Choose the correct answer from the options given below:

a. A, B and E only
b. A, B and D only
c. A, C, D and E only
d. A and B only

(Importance & Loss of Biodiversity)

34. These are regarded as major causes of biodiversity loss:

A. Over exploitation
B. Co-extinction
C. Mutation
D. Habitat loss and fragmentation
E. Migration

Choose the correct option:

a. A, B and E only
b. A, B and D only
c. A, C and D only
d. A, B, C and D only

35. List of endangered species was released by-

a. FOAM
b. IUCN
c. GEAC
d. WWF

Botany

Section-B

Plant Kingdom

(Algae)

36. Read the following statements and choose the set of correct statements.

A. Asexual reproduction occurs usually by biflagellate zoospores in the members of Phaeophyceae.
B. Sexual reproduction is by oogamous method only.
C. Stored food is in the form of carbohydrates which is either mannitol or laminarin.
D. The major pigments found are chlorophyll a, c and carotenoids and xanthophyll.
E. Vegetative cells have a cellulosic wall, usually covered on the outside by gelatinous coating of algin.

Choose the correct answer from the options given below:

a. A, C, D and E only
b. A, B, C and E only
c. A, B, C and C only
d. B, C, D and E only

Morphology of Flowering Plants

(The Flower)

37. Match List-I with List-II.

	List-I		List-II
(A)	Rose	(I)	Twisted aestivation
(B)	Pea	(II)	Perigynous flower
(C)	Cotton	(III)	Drupe
(D)	Mango	(IV)	Marginal placentation

Choose the correct answer from the options given below:

a. A-(IV), B-(III), C-(II), D-(I)
b. A-(II), B-(III), C-(IV), D-(I)
c. A-(II), B-(IV), C-(I), D-(III)
d. A-(I), B-(II), C-(III), D-(IV)

38. Match List-I with List-II.

	List-I (Types of stamen)		List-II (Example)
(A)	Monoadelphous	(I)	Citrus
(B)	Diadelphous	(II)	Pea
(C)	Polyadelphous	(III)	Lily
(D)	Epiphyllous	(IV)	China-rose

Choose the correct answer from the option below:

a. A-(I), B-(II), C-(IV), B-(III)
b. A-(III), B-(I), C-(IV), D-(II)
c. A-(IV), B-(II), C-(I), D-(III)
d. A-(IV), B-(I), C-(II), D-(III)

Cell The Unit of Life

(Mitochondria, Plastids, Ribosomes)

39. The DNA present in chloroplast is:

a. Linear, single stranded
b. Circular, single stranded
c. Linear, double stranded
d. Circular, double stranded

Biomolecules

(Biomacromolecules, Proteins)

40. Match List-I with List-II.

	List-I		List-II
(A)	GLUT-4	(I)	Hormone
(B)	Insulin	(II)	Enzyme
(C)	Trypsin	(III)	Intercellular ground substance
(D)	Collagen	(IV)	Enables glucose transport into cells

Choose the correct answer from the options given below:

a. A-(II) B-(III), C-(IV), D-(I)
b. A-(III), B-(IV), C-(I), D-(II)
c. A-(IV), B-(I), C-(II), D-(III)
d. A-(I), B-(II), C-(III), D-(IV)

Plant Growth and Development

(Plant Growth Regulators)

41. Spraying sugarcane crop with which of the following plant growth regulators, increases the length of stem, thus, increasing the yield?

a. Cytokinin
b. Abscisic acid
c. Auxin
d. Gibberellin

Photosynthesis in Higher Plants

(C4 Pathway & Photorespiration)

42. Given below are two statements:

Statement I: In C_3 plants, some O_2 binds RuBisCO, hence CO_2 fixation is decreased.

Statement II: In C_4 plants, mesophyll cells shows very little photorespiration while bundle sheath cells do not show photorespiration.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is true but Statement II is false
b. Statement I is false but Statement II is true
c. Both Statement I and Statement II are true
d. Both Statement I and Statement II are false

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Respiration in Plants

(Aerobic Respiration)

43. Identify the step in tricarboxylic acid cycle, which does not involve oxidation of substrate.
a. Succinyl-CoA → Succinic acid
b. Isocitrate → α-ketoglutaric acid
c. Malic acid → Oxaloacetic acid
d. Succinic acid → Malic acid

44. Match List-I with List-II

List-I		List-II	
(A)	Citric acid cycle	(I)	Cytoplasm
(B)	Glycolysis	(II)	Mitochondrial matrix
(C)	Electron transport	(III)	Intermembrane space of mitochondria
(D)	Proton gradient	(IV)	Inner mitochondrial membrane

Choose the correct answer from the option given below:
a. A-(III), B-(IV), C-(I), D-(II)
b. A-(IV), B-(III), C-(II), D-(I)
c. A-(I), B-(II), C-(III), D-(IV)
d. A-(II), B-(I), C-(IV), D-(III)

Sexual Reproduction in Flowering Plants

(Flower and Pre-fertilisation)

45. Identify the correct description about the given figure:

a. Cleistogamous flowers showing autogamy.
b. Compact inflorescence showing complete autogamy.
c. Wind pollinated plant inflorescence showing flowers with well exposed stamens.
d. Water pollinated flowers showing stamens with mucilaginous covering.

Molecular Basis of Inheritance

(Regulation of Gene Expression)

46. Match List-I with List-II

List-I		List-II	
(A)	Frederick Griffith	(I)	Genetic code
(B)	Francois Jacob & Jacque	(II)	Semi-conservative mode of DNA replication
(C)	Har Gobind Khorana	(III)	Transformation
(D)	Meselson & Stahl	(IV)	*Lac* operon

Choose the correct answer from the options given below:
a. A-(II), B-(III), C-(IV), D-(I)
b. A-(IV), B-(I), C-(II), D-(III)
c. A-(III), B-(II), C-(I), D-(IV)
d. A-(III), B-(IV), C-(I), D-(II)

(Replication)

47. Which of the following statement is correct regarding the process of replication in *E.coli*?
a. The DNA dependent DNA polymerase catalyses polymerization in 5' → 3' as well as 3' → 5' direction.
b. The DNA dependent DNA polymerase catalyses polymerization in 5' → 3 ' direction.
c. The DNA dependent DNA polymerase catalyses polymerization in one direction that is 3' → 5'.
d. The DNA dependent RNA polymerase catalyses polymerization in one direction, that is 5' → 3'.

Biotechnology and Its Applications

(Biotechnological Applications in Agriculture)

48. Which of the following are fused in somatic hybridization involving two varieties of plants?
a. Protoplasts
b. Pollens
c. Callus
d. Somatic embryos

Ecosystem

(Productivity)

49. In an ecosystem if the Net Primary Productivity (NPP) of first trophic level is 100x (kcalm^{-2}) yr^{-1}, what would be the GPP (Gross Primary Productivity') of the third trophic level of the same ecosystem?
a. $10x\ (kcalm^{-2})\ yr^{-1}$
b. $\frac{100x}{3x}\ (kcalm^{-2})\ yr^{-1}$
c. $\frac{x}{10}\ (kcalm^{-2})\ yr^{-1}$
d. $x\ (kcalm^{-2})\ yr^{-1}$

Biodiversity and Conservation

(Importance & Loss of Biodiversity)

50. Match List-I with List-II.

List-I		List-II	
(A)	Robert May	(I)	Species-Area relationship
(B)	Alexander von Humboldt	(II)	Long term ecosystem experiment using out door plots
(C)	Paul Ehrlich	(III)	Global species diversity at about 7 million
(D)	David Tilman	(IV)	Rivet popper hypothesis

Choose the correct answer from the options given below:
a. A-(I), B-(III), C-(II), D-(IV)
b. A-(III), B-(IV), C-(II), D-(I)
c. A-(II), B-(III), C-(I), D-(IV)
d. A-(III), B-(I), C-(IV), D-(II)

Zoology

Section-A

Animal Kingdom

(Basis of Classification)

51. Consider the following statements:
A. Annelids are true coelomates
B. Poriferans are pseudocoelomates
C. Aschelminthes are acoelomates
D. Platyhelminthes are pseudocoelomates
Choose the correct answer from the options given below :
a. C only
b. D only
c. B only
d. A only

(Class Cyclostomata, Chondrichythes, Osteichythes)

52. Match List-I with List-II:

List-I		List-II	
(A)	*Pleurobrachia*	(I)	Mollusca
(B)	Radula	(II)	Ctenophora
(C)	Stomochord	(III)	Osteichthyes
(D)	Air bladder	(IV)	Hemichordata

Choose the correct answer from the options given below:
a. A-(II), B-(IV), C-(I), D-(III)
b. A-(IV), B-(III), C-(II), D-(I)
c. A-(IV), B-(II), C-(III), D-(I)
d. A-(II), B-(I), C-(IV), D-(III)

53. Match List-I with List-II:

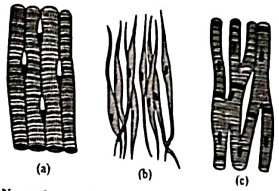
List-I		List-II	
(A)	*Pterophyllum*	(I)	Hag fish
(B)	*Myxine*	(II)	Saw fish
(C)	*Pristis*	(III)	Angel fish
(D)	*Exocoetus*	(IV)	Flying fish

Choose the correct answer from the options given below:
a. A-(IV), B-(I), C-(II), D-(III)
b. A-(III), B-(II), C-(I), D-(IV)
c. A-(II), B-(I), C-(III), D-(IV)
d. A-(III), B-(I), C-(II), D-(IV)

Structural Organisation in Animals

(Muscle Tissue & Neural Tissue)

54. Three types of muscles are given as a, b and c. Identify the correct matching pair along with their location in human body:



(a) (b) (c)

Name of muscle/location
a. (a) Skeletal - Biceps
(b) Involuntary - Intestine
(c) Smooth - Heart.
b. (a) Involuntary - Nose tip
(b) Skeletal - Bone
(c) Cardiac - Heart.
c. (a) Smooth - Toes
(b) Skeletal - Legs
(c) Cardiac - Heart.
d. (a) Skeletal-Triceps
(b) Smooth - Stomach
(c) Cardiac - Heart.

(Cockroach)

55. In both sexes of cockroach, a pair of jointed filamentous structures called anal cerci are present on :
a. 8th and 9th segment
b. 11th segment
c. 5th segment
d. 10th segment

Cell: The Unit of Life

(Nucleus and Microbodies)

56. Match List-I with List-II:

List-I		List-II	
(A)	Axoneme	(I)	Centriole
(B)	Cartwheel pattern	(II)	Cilia and flagella
(C)	Crista	(III)	Chromosome
(D)	Satellite	(IV)	Mitochondria

Choose the correct answer from the options given below :
a. A-(II), B-(IV), C-(I), D-(III)
b. A-(II), B-(I), C-(IV), D-(III)
c. A-(IV), B-(III), C-(II), D-(I)
d. A-(IV), B-(II), C-(III), D-(I)

Biomolecules

(Polysaccharides, Nucleic Acids & Types of Bond)

54. Match List I with List II

List I		List II	
(A)	Lipase	(I)	Peptide Bond
(B)	Nuclease	(II)	Ester Bond
(C)	Protease	(III)	Glycosidic Bond
(D)	Amylase	(IV)	Phosphodiester Bond

Choose the correct answer from the options given below:

a. A-(II), B-(IV), C-(I), D-(III)
b. A-(II), B-(I), C-(III), D-(II)
c. A-(IV), B-(III), C-(III), D-(I)
d. A-(III), B-(II), C-(I), D-(IV)

Cell Cycle and Cell Division

(Cell Cycle)

55. Following are the stages of cell division:

A. Gap 2 phase
B. Cytokinesis
C. Synthesis phase
D. Karyokinesis
E. Gap 1 phase

Choose the correct sequence of stages from the options given below:

a. B-D-E-A-C
b. E-C-A-D-B
c. C-E-D-A-B
d. E-B-D-A-C

56. Match List-I with List-II:

List-I (Sub Phases of Prophase I)		List-II (Specific characters)	
(A)	Diakinesis	(I)	Synaptonemal complex formation
(B)	Pachytene	(II)	Completion of terminalisation of chiasmata
(C)	Zygotene	(III)	Chromosomes look like thin threads
(D)	Leptotene	(IV)	Appearance of recombination nodules

Choose the correct answer from the options given below;

a. A-(II), B-(IV), C-(I), D-(III)
b. A-(IV), B-(III), C-(II), D-(I)
c. A-(IV), B-(II), C-(III), D-(I)
d. A-(I), B-(II), C-(IV), D-(III)

Breathing and Exchange of Gases

(Respiratory Volumes & Capacities)

57. Match List I with List II

List I		List II	
(A)	Expiratory capacity	(I)	Expiratory reserve volume + Tidal volume + Inspiratory reserve volume
(B)	Functional residual capacity	(II)	Tidal volume + Expiratory reserve volume
(C)	Vital capacity	(III)	Tidal volume + Inspiratory reserve volume
(D)	Inspiratory capacity	(IV)	Expiratory reserve volume + Residual volume

Choose the correct answer from the options given below:

a. A-(II), B-(I), C-(IV), D-(III)
b. A-(II), B-(III), C-(I), D-(IV)
c. A-(III), B-(IV), C-(II), D-(III)
d. A-(III), B-(II), C-(IV), D-(I)

(Exchange and Transport of Gases)

61. Which of the following factors are favourable for the formation of oxyhaemoglobin in alveoli?

a. Low pCO_2 and High H^+ concentration
b. Low pCO_2 and High temperature
c. High pO_2 and High pCO_2
d. High pO_2 and Lesser H^+ concentration

Body Fluids and Circulation

(Circulatory Pathways)

62. Following are the stages of pathway for conduction of an action potential through the heart:

A. AV bundle
B. Purkinje fibers
C. AV node
D. Bundle branches
E. SA node

Choose the correct sequence of pathway from the options given below:

a. B-D-E-C-A
b. E-A-D-B-C
c. E-C-A-D-B
d. A-E-C-B-D

Excretory Products and Their Elimination

(Urine Formation, Function of Tubules)

63. Given below are two statements:

Statement I: In the nephron, the descending limb of loop of Henle impermeable to water and permeable to electrolytes.

Statement II: The proximal convoluted tubule is lined by simple columnar brush border epithelium and increases the surface area for reabsorption.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is false but Statement II is false
b. Statement I is false but Statement II is true
c. Both Statement I and Statement II are true
d. Both Statement I and Statement II are false

Locomotion and Movement

(Joints)

64. Match List I with List II

List I		List II	
(A)	Fibrous joints	(I)	Adjacent vertebrae, limited movement
(B)	Cartilaginous joints	(II)	Humerus and Pectoral girdle, rotational movement
(C)	Hinge joints	(III)	Skull, don't allow any movement
(D)	Ball and socket joints	(IV)	Knee, help in locomotion

Choose the correct answer from the options given below:

a. A-(II), B-(III), C-(I), D-(IV)
b. A-(III), B-(II), C-(IV), D-(I)
c. A-(IV), B-(III), C-(III), D-(I)
d. A-(II), B-(III), C-(II), D-(IV)

(Disorders of Muscular and Skeletal System)

65. Which of the following are Autoimmune disorders?

A. Myasthenia gravis
B. Rheumatoid arthritis
C. Gout
D. Muscular dystrophy
E. Systemic Lupus Erythematosus (SLE)

Choose the most appropriate answer from the options given below:

a. B, C & E only
b. C, D & E only
c. A, B & D only
d. A, B & E only

Neural Control and Coordination

(Central Nervous System)

66. Match List-I with List-II:

List-I		List-II	
(A)	Pons	(I)	Provides additional space for Neurons, regulates posture and balance.
(B)	Hypothalamus	(II)	Controls respiration and gastric secretions.
(C)	Medulla	(III)	Connects different regions of the brain.
(D)	Cerebellum	(IV)	Neuro secretory cells

Choose the correct answer from the options given below:

a. A-(III), B-(II), C-(I), D-(IV)
b. A-(III), B-(I), C-(II), D-(IV)
c. A-(II), B-(III), C-(I), D-(IV)
d. A-(III), B-(IV), C-(II), D-(I)

Chemical Coordination and Integration

(Mechanism of Hormone Action)

67. Which of the following is not a steroid hormone?

a. Progesterone
b. Oxytocin
c. Cortisol
d. Testosterone

Human Reproduction

(Female Reproductive System)

68. Given below are two statements:

Statement I: The presence or absence of hymen is not a reliable indicator of virginity.

Statement II: The hymen is torn during the first coitus only.

In the light of the above statements, choose the correct answer from the options given below:

a. Statement I is true but Statement II is false
b. Statement I is false but Statement II is true
c. Both Statement I and Statement II are true
d. Both Statement I and Statement II are false

69. Which of the following is not a component of Fallopian tube?

a. Infundibulum
b. Ampulla
c. Uterine fundus
d. Isthmus

(Menstrual Cycle)

70. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: FSH acts upon ovarian follicles in female and Leydig cells in male.

Reason R: Growing ovarian follicles secrete estrogen in female while interstitial cells secrete androgen in male human being.

In the light of the above statements, choose the correct answer from the options given below:

a. A is true but R is false
b. A is false but R is true
c. Both A and R are true and R is the correct explanation of A
d. Both A and R are true but R is NOT the correct explanation of A.

(Parturition and Lactation)

71. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: Breast-feeding during initial period of infant growth is recommended by doctors for bringing a healthy baby.

Reason R : Colostrum contains several antibodies absolutely essential to develop resistance for the new born baby.

Choose the correct answer from the options given below.

a. A (II) B (III) C (IV) D (I)
b. A (III) B (I) C (II) D (IV)
c. A (II) B (III) C (I) D (IV)
d. A (III) B (IV) C (II) D (I)

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In the light of the above statements, choose the most appropriate answer from the options given below :

a. A is correct but R is not correct.

b. A is not correct but R is correct.

c. Both A and R are correct and R is the correct explanation of A

d. Both A and R are correct but R is NOT the correct explanation of A.

Reproductive Health

(Population Stabilisation and Birth Control)

72. Match List-I with List-II:

List-I		List-II	
(A)	Non-medicated IUD	(I)	Multiload 375
(B)	Copper releasing IUD	(II)	Progestogens
(C)	Hormone releasing IUD	(III)	Lippes loop
(D)	Implants	(IV)	LNG - 20

Choose the correct answer from the options given below:

a. A-(IV), B-(I), C-(II), D-(III)

b. A-(III), B-(I), C-(IV), D-(II)

c. A-(III), B-(I), C-(II), D-(IV)

d. A-(I), B-(III), C-(IV), D-(II)

73. Which of the following is not a natural/traditional contraceptive method?

a. Lactational amenorrhea

b. Vaults

c. Coitus interruptus

d. Periodic abstinence

Principles of Inheritance and Variation

(Genetic Disorders)

74. Match List-I with List-II:

List-I		List-II	
(A)	Down's syndrome	(I)	11th chromosome
(B)	α-Thalassemia	(II)	'X' chromosome
(C)	β-Thalassemia	(III)	21st chromosome
(D)	Klinefelter's syndrome	(IV)	16th chromosome

Choose the correct answer from the options given below:

a. A-(III), B-(IV), C-(I), D-(II)

b. A-(IV), B-(I), C-(II), D-(III)

c. A-(I), B-(II), C-(III), D-(IV)

d. A-(II), B-(III), C-(IV), D-(I)

Molecular Basis of Inheritance

(Transcription)

75. Which one is the correct product of DNA dependent RNA polymerase to the given template?

3'TACATGGCAAATATCCATTCA5'

a. 5'AUGUACCGUUUAUAGGGAAGU3'

b. 5'ATGTACCGTTTATAGGTAAGT3'

c. 5'AUGUACCGUUUAUAGGUAAGU3'

d. 5'AUGUAAAGUUUAUAGGUAAGU3'

Evolution

(Evidences of Evolution)

76. The flippers of the Penguins and Dolphins are the example of the

a. Convergent evolution b. Divergent evolution

c. Adaptive radiation d. Natural selection

(Hardy-Weinberg Principle)

77. Which one of the following factors will not affect the Hardy-Weinberg equilibrium?

a. Gene migration b. Constant gene pool

c. Genetic recombination d. Genetic drift

(Human Evolution)

78. Given below are some stages of human evolution. Arrange them in correct sequence. (Past to Recent)

A. *Homo habilis*

B. *Homo sapiens*

C. *Homo neanderthalensis*

D. *Homo erectus*

Choose the correct sequence of human evolution from the options given below:

a. C-B-D-A b. A-D-C-B

c. D-A-C-B d. B-A-D-C

Human Health and Diseases

(Common Diseases in Humans)

79. Match List-I with List-II:

List-I		List-II	
(A)	Typhoid	(I)	Fungus
(B)	Leishmaniasis	(II)	Nematode
(C)	Ringworm	(III)	Protozoa
(D)	Filariasis	(IV)	Bacteria

Choose the correct answer from the options given below:

a. A-(III), B-(I), C-(IV), D-(II)

b. A-(II), B-(IV), C-(III), D-(I)

c. A-(I), B-(III), C-(II), D-(IV)

d. A-(IV), B-(III), C-(I), D-(II)

80. Match List-I with List-II:

List-I		List-II	
(A)	Common cold	(I)	*Plasmodium*
(B)	Haemozoin	(II)	Typhoid
(C)	Widal test	(III)	*Rhinoviruses*
(D)	Allergy	(IV)	Dust mites

Choose the correct answer from the options given below:

a. A-(III), B-(I), C-(II), D-(IV)

b. A-(IV), B-(II), C-(III), D-(I)

c. A-(II), B-(IV), C-(III), D-(I)

d. A-(I), B-(III), C-(II), D-(IV)

(Drugs & Alcohol Abuse)

81. Match List-I with List-II:

List-I		List-II	
(A)	Cocaine	(I)	Effective sedative in surgery
(B)	Heroin	(II)	*Cannabis sativa*
(C)	Morphine	(III)	*Erythroxylum*
(D)	Marijuana	(IV)	*Papaver somniferum*

Choose the correct answer from the options given below :

a. A-(II), B-(I), C-(III), D-(IV)

b. A-(III), B-(IV), C-(I), D-(II)

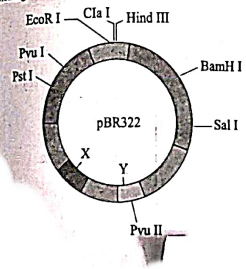
c. A-(IV), B-(III), C-(I), D-(II)

d. A-(I), B-(III), C-(II), D-(IV)

Biotechnology: Principles and Processes

(Tools of Recombinant DNA Technology)

82. The following diagram showing restriction sites in *E. coli* cloning vector pBR322. Find the role of '*X*' and '*Y*' genes :



a. The gene '*X*' is for protein involved in replication of Plasmid and '*Y*' for resistance to antibiotics.

b. Gene '*X*' is responsible for recognition sites and '*Y*' is responsible for antibiotic resistance.

c. The gene '*X*' is responsible for resistance to antibiotics and '*Y*' for protein involved in the replication of Plasmid.

d. The gene '*X*' is responsible for controlling the copy number of the linked DNA and '*Y*' for protein involved in the replication of Plasmid.

83. The "Ti plasmid" of *Agrobacterium tumefaciens* stands for

a. Tumor inducing plasmid

b. Temperature independent plasmid

c. Tumour, inhibiting plasmid

d. Tumor independent plasmid

(Processes of Recombinant DNA Technology)

84. Which of the following statements is incorrect?

a. Bio-reactors are used to produce small scale bacterial cultures.

b. Bio-reactors have an agitator system, an oxygen delivery system and foam control system.

c. A bio-reactor provides optimal growth conditions for achieving the desired product.

d. Most commonly used bio-reactors are of stirring type.

Biotechnology and Its Applications

(Transgenic Animals)

85. Match List-I with List-II:

List-I		List-II	
(A)	α - 1 antitrypsin	(I)	Cotton bollworm
(B)	*Cry IAb*	(II)	ADA deficiency
(C)	*Cry IAc*	(III)	Emphysema
(D)	Enzyme replacement therapy	(IV)	Corn borer

Choose the correct answer from the options given below :

a. A-(III), B-(IV), C-(I), D-(II)

b. A-(II), B-(IV), C-I D-(III)

c. A-(II), B-(I), C-(IV), D-(III)

d. A-(III), B-(I), C-(II), D-(IV)

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Zoology

Section-B

Animal Kingdom

(Hemichordata and Chordata)

86. The following are the statements about non-chordates:

A. Pharynx is perforated by gill slits.
B. Notochord is absent.
C. Central nervous system is dorsal.
D. Heart is dorsal if present.
E. Post anal tail is absent.

Choose the most appropriate answer from the options given below:

a. B, D & E only
b. B, C & D only
c. A & C only
d. A, B & D only

Structural Organisation in Animals

(Epithelial & Connective Tissue)

87. Match List-I with List-II:

List-I		List-II	
(A)	Unicellular glandular epithelium	(I)	Salivary glands
(B)	Compound epithelium	(II)	Pancreas
(C)	Multicellular glandular epithelium	(III)	Goblet cells of alimentary canal
(D)	Endocrine glandular epithelium	(IV)	Moist surface of buccal cavity

Choose the correct answer from the options given below:

a. A-(III), B-(IV), C-(I), D-(II)
b. A-(II), B-(I), C-(IV), D-(III)
c. A-(II), B-(I), C-(III), D-(IV)
d. A-(IV), B-(III), C-(I), D-(II)

(Cockroach)

88. Match List-I with List-II related to digestive system of cockroach.

List-I		List-II	
(A)	The structures used for storing of food.	(I)	Gizzard
(B)	Ring of 6-8 blind tubules at junction of foregut and midgut.	(II)	Gastric Caeca
(C)	Ring of 100-150 yellow coloured thin filaments at junction of midgut and hindgut.	(III)	Malpighian tubules
(D)	The structures used for grinding the food	(IV)	Crop

Choose the correct answer from the options given below:

a. A-(IV), B-(III), C-(II), D-I
b. A-(III), B-(II), C-(IV), D-I
c. A-(IV), B-(II), C-(III), D-I
d. A-(I), B-(II), C-(III), D-IV

Cell: The Unit of Life

(Mitochondria, Plastids, Ribosomes)

89. Given below are two statements:

Statement I: Mitochondria and chloroplasts are both double membrane bound organelles.

Statement II: Inner membrane of mitochondria is relatively less permeable, as compared to chloroplast.

In the light of the above statements, choose the most appropriate answer from the options given below:

a. Statement I is correct but Statement II is incorrect.
b. Statement I is incorrect but Statement II is correct.
c. Both Statement I and Statement II are correct.
d. Both Statement I and Statement II are incorrect.

Biomolecules

(Enzymes)

90. Regarding catalytic cycle of an enzyme action select the correct sequential steps :

A. Substrate enzyme complex formation.
B. Free enzyme ready to bind with another substrate.
C. Release of products.
D. Chemical bonds of the substrate broken.
E. Substrate binding to active site.

Choose the correct answer from the options given below :

a. B, A, C, D, E
b. E, D, C, B, A
c. E, A, D, C, B
d. A, E, B, D, C

Body Fluids and Circulation

(Circulatory Pathways)

91. Match List-I with List-II:

List-I		List-II	
(A)	P wave	(I)	Heart muscles are electrically silent.
(B)	QRS complex	(II)	Depolarisation of ventricles.
(C)	T wave	(III)	Depolarisation of atria.
(D)	T-P gap	(IV)	Repolarisation of ventricles.

Choose the correct answer from the options given below:

a. A-(III), B-(IV), C-(I), D-(IV)
b. A-(IV), B-(II), C-(I), D-(III)
c. A-(I), B-(III), C-(IV), D-(II)
d. A-(III), B-(II), C-(IV), D-(I)

Excretory Products and Their Elimination

(Excretory Organs, Human Excretory System)

92. Choose the correct statement given below regarding juxta medullary nephron.

a. Loop of Henle of juxta medullary nephron runs deep into medulla.
b. Juxta medullary nephrons outnumber the cortical nephrons.
c. Juxta medullary nephrons are located in the columns of Bertini.
d. Renal corpuscle of juxta medullary nephron lies in the outer portion of the renal medulla.

Neural Control and Coordination

(Central Nervous System)

93. Given below are two statements:

Statement I: The cerebral hemispheres are connected by nerve tract known as corpus callosum.

Statement II: The brain stem consists of the medulla oblongata, pons and cerebrum.

In the light of the above statements, choose the most appropriate answer from the options given below:

a. Statement I is correct but Statement II is incorrect.
b. Statement I is incorrect but Statement II is correct.
c. Both Statement I and Statement II are correct.
d. Both Statement I and Statement II are incorrect.

Chemical Coordination and Integration

(Adrenal gland, Pancreas)

94. Match List-I with List-II:

List-I		List-II	
(A)	Exophthalmic goitre	(I)	Excess secretion of cortisol, moon face and hyperglycemia
(B)	Acromegaly	(II)	Hypo-secretion of thyroid hormone and stunted growth
(C)	Cushing's syndrome	(III)	Hyper secretion of thyroid hormone and protruding eye balls.
(D)	Cretinism	(IV)	Excessive secretion of growth hormone

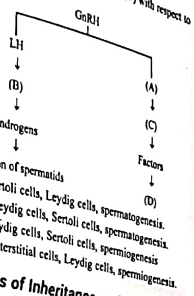
Choose the correct answer from the options given below:

a. A-(III), B-(IV), C-(II), D-(I)
b. A-(III), B-(IV), C-(I), D-(II)
c. A-(I), B-(III), C-(II), D-(IV)
d. A-(IV), B-(II), C-(I), D-(III)

Human Reproduction

(Gametogenesis)

95. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis.



a. FSH, Sertoli cells, Leydig cells, spermatogenesis.
b. ICSH, Leydig cells, Sertoli cells, spermiogenesis.
c. FSH, Leydig cells, Sertoli cells, spermiogenesis.
d. ICSH, Interstitial cells, Leydig cells, spermiogenesis.

Principles of Inheritance and Variation

(Mendal's Laws of Inheritance And Inheritance of One Gene)

96. As per ABO blood grouping system, the blood group of father is B^+, mother is A^+ and child is O^+. Their respective genotype can be

A. $I^BI^B/I^AI^A/ii$
B. $I^BI^B/I^AI^A/Ii$
C. $I^AI^B/IiI^B/I^Ii$
D. $I^AI^B/I^Bi/I^Ai$
E. $IB/IiI^A/I^Ai$

Choose the most appropriate answer from the options given below:

a. C & B only
b. D & E only
c. A only
d. B only

Molecular Basis of Inheritance

(Transcription)

97. Match List-I with List-II:

List-I		List-II	
(A)	RNA polymerase III	(I)	snRNPs
(B)	Termination of transcription	(II)	Promotor
(C)	Splicing of Exons	(III)	Rho factor
(D)	TATA box	(IV)	SnRNAs, tRNA

Choose the correct answer from the options given below:

a. A-(III), B-(IV), C-(I), D-(II)
b. A-(IV), B-(III), C-(I), D-(II)
c. A-(II), B-(IV), C-(I), D-(III)
d. A-(III), B-(II), C-(IV), D-(I)

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Evolution

(Brief Account of Evolution)

98. Match List-I with List-II:

List-I		List-II	
(A)	Mesozoic Era	(I)	Lower invertebrates
(B)	Proterozoic Era	(II)	Fish & Amphibia
(C)	Cenozoic Era	(III)	Birds & Reptiles
(D)	Paleozoic Era	(IV)	Mammals

Choose the correct answer from the options given below:

a. A-(I), B-(II), C-(IV), D-(III)
b. A-(III), B-(I), C-(IV), D-(II)
c. A-(II), B-(I), C-(III), D-(IV)
d. A-(III), B-(I), C-(II), D-(IV)

Human Health and Diseases

(Immunity)

99. Given below are two statements:

Statement I: Bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

Statement II: Both bone marrow and thymus provide micro environments for the development and maturation of T-lymphocytes.

In the light of the above statements, choose the most appropriate answer from the options given below:

a. Statement I is correct but Statement II is incorrect.
b. Statement I is incorrect but Statement II is correct.
c. Both Statement I and Statement II are correct.
d. Both Statement I and Statement II are incorrect.

Organisms and Populations

(Population Interactions)

100. Given below are two statements :

Statement I: Gause's competitive exclusion principle states that two closely related species competing for different resources cannot exists indefinitely.

Statement II: According to Gause's principle during competition, the inferior will be eliminated. This may be true if resources are limiting.

In the light of the above statements, choose correct answer from the options given below:

a. Statement I is true but Statement II is false.
b. Statement I is false but Statement II is true.
c. Both Statement I and Statement II are true.
d. Both Statement I and Statement II are false.

Answer Key

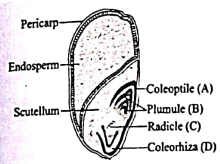
1. (d)	2. (c)	3. (a)	4. (b)	5. (c)	6. (c)	7. (c)	8. (b)	9. (c)	10. (a)
11. (c)	12. (d)	13. (d)	14. (c)	15. (a)	16. (b)	17. (a)	18. (a)	19. (b)	20. (d)
21. (d)	22. (a)	23. (d)	24. (b)	25. (a)	26. (a)	27. (d)	28. (a)	29. (c)	30. (a)
31. (a)	32. (d)	33. (c)	34. (b)	35. (b)	36. (a)	37. (c)	38. (c)	39. (d)	40. (c)
41. (d)	42. (a)	43. (a)	44. (d)	45. (c)	46. (d)	47. (b)	48. (a)	49. (a)	50. (d)
51. (d)	52. (d)	53. (d)	54. (d)	55. (d)	56. (b)	57. (a)	58. (b)	59. (a)	60. (c)
61. (d)	62. (c)	63. (d)	64. (b)	65. (d)	66. (d)	67. (b)	68. (a)	69. (c)	70. (b)
71. (c)	72. (b)	73. (b)	74. (a)	75. (c)	76. (a)	77. (b)	78. (b)	79. (d)	80. (a)
81. (b)	82. (d)	83. (a)	84. (a)	85. (a)	86. (a)	87. (a)	88. (c)	89. (a)	90. (c)
91. (d)	92. (a)	93. (a)	94. (b)	95. (c)	96. (c)	97. (b)	98. (b)	99. (c)	100. (b)

Explanations

1. (d) The morphology of the mycelium, mode of spore formation and fruiting bodies form the basis for the division of the kingdom fungi into various classes. All fungi derive their nutrition through heterotrophic mode of nutrition.

2. (c) Some common members of basidiomycetes are *Agaricus* (mushroom) , *Ustilago* (smut) and *Puccinia* (rust fungus). *Rhizopus* is also known as the bread mould. It belongs to Phycomycetes.

3. (a) The primary root, or radicle is the first organ to appear when a seed germinates.



4. (b) Given figures (A) and (B) shows perigynous flower. In this, gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level. The ovary here is said to be half inferior, e.g., plum, rose, peach.

5. (c) *Datura* is an example of actinomorphic flower as their flowers can be divided into two equal radial halves in any radial plane passing through the centre.

6. (c) In monocots, under water stress condition, bulliform cells becomes flaccid that makes the leaves curl inwards to minimise water loss.

7. (c) In the given figure of stomata with bean shaped guard cells, A-Epidermal cells, B-Subsidiary cells, C-Guard cells, D-Stomatal pore.
The outer walls of guard cells (away from the stomatal pore) are thin and the inner walls (towards the stomatal pore) are highly thickened.

8. (b) Parenchyma and collenchyma are living tissue. Gymnosperms lack vessels in their xylem but in flowering plants, tracheids and vessels are the main water transporting elements.

9. (c)
A. Nucleolus - site for active ribosomal RNA synthesis.
B. Centriole - organisation like cartwheel
C. Leucoplasts - for storing nutrients
D. Golgi apparatus- site for formation of glycolipid

10. (a) Inhibition of succinic dehydrogenase by malonate is an example of competitive inhibition. Malonate resembles the substrate succinate and competes with the substrate for the substrate-binding site of the enzyme. Consequently, the substrate cannot bind and as a result, the enzyme action declines.

11. (c) Metal ions are the common cofactors. Cofactor for enzyme carboxypeptidase is zinc.

12. (d) Lecithin or phosphatidyl choline, a small molecular a weight organic compound found in living tissues, is an example of phospholipid.

13. (d) Spindle fibres attach to kinetochores of chromosomes during metaphase stage.
Chromosomes are moved to spindle equator and get aligned along metaphase plate through spindle fibres to both poles.

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14. (c) During leptotene stage the chromosomes become gradually visible under the light microscope.

The beginning of diplotene is recognised by the dissolution of the synaptonemal complex and the tendency of the recombined homologous chromosomes of the bivalents to separate from each other except at the sites of crossovers.

15. (a) For the dark reaction or Calvin cycle, CO_2 is required for the carboxylation step and ATP and NADH are required for the reduction and regeneration step.

16. (b) For every CO_2 molecule entering the Calvin cycle, 3 molecules of ATP and 2 of NADPH are required.

The Calvin cycle can be described under three stages: carboxylation, reduction and regeneration.

Reduction step involve utilisation of 2 molecules of ATP for phosphorylation and two of NADPH for reduction per CO_2 molecule fixed. The regeneration steps require one ATP for phosphorylation to form RuBP.

17. (a) Plants show an interesting phenomenon, the living differentiated cells, that by now have lost the capacity to divide can regain the capacity of division under certain conditions. This phenomenon is termed as dedifferentiation. For example, formation of meristems – interfascicular cambium and cork cambium from fully differentiated parenchyma cells.

18. (a) Auxins are widely used as herbicides. 2, 4-D, widely used to kill dicotyledonous weeds, does not affect mature monocotyledonous plants.

19. (b) *Vallisneria* is a water pollinated flowers which are not very colourful and do not produce nectar.

In most of the water-pollinated species, pollen grains are protected from wetting by a mucilaginous covering.

In water lily, the flowers emerge above the level of water and are pollinated by insects or wind.

Pollen grains in many water pollinated plants like seagrasses are long, ribbon like and they are carried passively inside the water; some of them reach the stigma and achieve pollination.

20. (d) To determine the genotype of the black seed plant, a test cross is performed with a homozygous recessive (bb) individual. This cross will reveal whether the black seed plant is homozygous dominant (BB) or heterozygous (Bb) based on the offspring's phenotypes.

Pink flowered snapdragon plant (Rr) × Red flowered snapdragon plant (RR)

Pink flower →	R	r
R	RR	Rr
Red flower → R	RR	Rr

50% flowers are red in colour and 50% flowers are pink in colour.

22. (a) Two or more alternative forms of a gene- Allele

Cross of F_1 progeny with homozygous recessive parent- Test cross

Cross of F_1 progeny with any of the parents- Back cross

Number of chromosome sets in plant- Ploidy

23. (d) Alleles show expressions in the F_2 generation.

24. (b) A transcription unit in DNA is defined primarily by the three regions in the DNA:

(i) A Promoter

(ii) The Structural gene

(iii) A Terminator

25. (a) In the absence of a preferred carbon source such as glucose, if lactose is provided in the growth medium of the bacteria, the lactose is transported into the cells through the action of permease.

26. (a)
- *Clostridium butylicum* - Butyric acid
- *Saccharomyces cerevistlae*- Ethanol
- *Trichoderma polysporum*- Cyclosporin-A
- *Streptococcus* sp.- Streptokinase

27. (d) Recognition sequence of first restriction endonuclease *Hind* II is of 6 base pairs and it generates blunt ends.

28. (a) When a piece of DNA carrying gene of interest is transferred into an alien organism – it may get integrated itself into the genome of the recipient and may multiply and be inherited along with the host DNA.

29. (c) The capacity to generate a whole plant from any cell of the plant is called totipotency.

30. (a) *Bt* toxins are insect-group specific. The toxin is coded by a gene *cry*IAc named *cry*.

The *Bt* toxin protein exist as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals.

31. (a) Verhulst-Pearl Logistic Growth is described by the following equation:

$$dN/dt = rN\left(\frac{K-N}{K}\right)$$

Where N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

32. (d) *Ex situ* Conservation– In this approach, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care. Zoological parks, botanical gardens and wildlife safari parks serve this purpose.

33. (c) Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.

Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity.

There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

34. (b) Causes of biodiversity losses: The accelerated rates of species extinctions that the world is facing now are largely due to human activities. There are four major causes (' The Evil Quartet ' is the sobriquet used to describe them).

1. Habitat loss and fragmentation
2. Over-exploitation
3. Alien species invasions
4. Co-extinctions

35. (b) The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years.

36. (a) Sexual reproduction can be isogamous, anisogamous or oogamous in phaeophyceae.

37. (c)

Rose	Perigynous flower
Pea	Marginal placentation
Cotton	Twisted aestivation
Mango	Drupe

38. (c)

Monoadelphous	China rose
Diadelphous	Pea
Polyadelphous	Citrus
Epiphyllous	Lily

39. (d) Chloroplast contains small, double- stranded circular DNA molecules and ribosomes.

40. (c)
- GLUT-4 enables glucose transport into cells.
- Insulin is a hormone secreted by pancreas.
- Trypsin is an example of enzyme.
- Collagen is the most abundant protein in animal world, which is an intercellular ground substances.

41. (d) Sugarcane stores carbohydrate as sugar in their stems. Spraying sugarcane crop with gibberellins increases the length of the stem, thus increasing the yield by as much as 20 tonnes per acre.

42. (a) In C_3 plants some O_2 does bind to RuBisCO, and hence CO_2 fixation is decreased. In C_4 plants photorespiration does not occur.

43. (a) The step in the tricarboxylic acid cycle that does not involve oxidation of substrate is

Succinyl-CoA → Succinic acid

This step involves the conversion of Succinyl-CoA to Succinic Acid by cleavage of CoA from Succinyl-CoA, which is a substrate-level phosphorylation, not an oxidation step.

44. (d)

Citric acid cycle	Mitochondrial matrix
Glycolysis	Cytoplasm
Electron transport system	Inner mitochondrial membrane
Proton gradient	Intermembrane space of mitochondria

45. (c) The given diagram shows a wind-pollinated plant showing compact inflorescence and well exposed stamens.

46. (d)

Frederick Griffith	Transformation
Francois Jacob and Jacque Monod	*Lac* operon
Har Gobind Khorana	Genetic code
Meselson and Stahl	Semi-conservative mode of DNA replication

47. (b) The DNA-dependent DNA polymerase in *E. coli* catalyse polymerisation only in one direction, that is 5' → 3'.

48. (a) Protoplasts fused in somatic hybridisation involving two varieties of plants.

49. (a) The NPP of the first trophic level is the GPP of the second trophic level and the NPP of the 2nd trophic level is GPP is 3rd trophic level.

According to the 10% law 90 per cent is the respiratory loss (R) at each trophic level.

NPP = GPP – R

At the first trophic level NPP is 100x which is GPP of second trophic level.

At second trophic level NPP is 10% of GPP = 10x

Since the GPP of the 3rd trophic level is the same as the NPP of the second trophic level, it is equal to 10x.

50. (d)

Robert May	Global species diversity at about 7 million
Alexander von Humboldt	Species-Area relationship
Paul Ehrlich	Rivet popper hypothesis
David Tilman	Long term ecosystem experiment using outdoor plots

51. (d)

Annelids – True coelomates

Poriferans to Platyhelminthes – Acoelomates

Aschelminthes – Pseudocoelomates

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52. **(d)** *Pleurobrachia* is the example of phylum ctenophora.
Radula is a file like rasping organ found in phylum mollusca.
Stomochord is found in phylum hemichordata similar to notochord of chordata.
Air - bladder maintains buoyancy in Osteichthyes.

53. **(d)** Scientific name of Angel fish is *Pterophyllum*.
Myxine is also known as hagfish.
Scientific name of saw fish is *Pristis*.
Scientific name of flying fish is *Exocoetus*.

54. **(d)**
Skeletal muscles: Triceps
Smooth muscles: Stomach
Cardiac muscles: Heart

55. **(d)** A pair of jointed filamentous structures called anal cerci are present on the 10th abdominal segment in both sexes of cockroaches.

56. **(b)** The core of cilia/flagella is called axoneme.
Centrioles have a '9+0' structure of triplet microtubules arranged in a cartwheel pattern.
Cristae are folds in the inner mitochondrial membrane.
Satellite is the term given to the end of a chromosome that is separated from the rest of the chromosome by a secondary constriction.

57. **(a)**

	List-I		List-II
A.	Lipase	II.	Ester bond
B.	Nuclease	IV.	Phosphodiester bond
C.	Protease	I.	Peptide bond
D.	Amylase	III.	Glycosidic bond

58. **(b)** The correct sequence of stages of cell division is:
Gap-1 phase → Synthesis phase → Gap-2 phase → Karyokinesis → Cytokinesis

59. **(a)**

Diakinesis	-	Completion of terminalisation of chiasmata
Pachytene	-	Appearance of recombination nodules
Zygotene	-	Synaptonemal complex formation
Leptotene	-	Chromosomes look like thin threads

(c)

	List-I		List-II
A.	Expiratory capacity	II.	Tidal Volume + Expiratory Reserve Volume
B.	Functional residual capacity	IV.	Expiratory Reserve Volume + Residual Volume
C.	Vital capacity	I.	Tidal Volume + Expiratory Reserve Volume + Inspiratory Reserve Volume
D.	Inspiratory capacity	III.	Tidal Volume + Inspiratory Reserve Volume

61. **(d)** Factors which are favourable for formation of oxyhaemoglobin in the alveoli – High pO_2, high pH, low pCO_2, lower temperature, lesser H^+ concentration.

62. **(c)** Correct sequence is –
SA node (E) → AV node (C) → AV bundle (A) → Bundle branches (D) → Purkinje fibres (B).

63. **(d)** Descending limb of Henle's loop - Permeable to water and impermeable to electrolytes.
Proximal convoluted tubule - Lined by simple cuboidal brush border epithelium.

64. **(b)**

List-I	List-II
Fibrous joints	Seen in flat skull bones and do not allow any movement.
Cartilaginous joints	Present between adjacent vertebrae and allow limited movements.
Hinge joints	Present in knees and help in locomotion.
Ball and socket joints	Present between humerus and pectoral girdle and allow rotational movement.

65. **(d)** Myasthenia gravis, Rheumatoid arthritis and Systemic Lupus Erythematosus are autoimmune disorders.
Gout is not an autoimmune disorder; it results from uric acid crystal accumulation. Muscular dystrophy is a genetic disorder, not autoimmune.

66. **(d)**

	List-I		List-II
A.	Pons	III.	Connects different regions of the brain
B.	Hypothalamus	IV.	Neurosecretory cells
C.	Medulla	II.	Controls respiration and gastric secretions
D.	Cerebellum	I.	Provides additional space for neurons, regulates posture and balance

67. **(b)** Glucagon is a peptide hormone secreted by the alpha cells of Islets of Langerhans of pancreas.
Remaining are steroidal hormones.

68. **(a)** The opening of the vagina is often covered partially by a membrane called hymen. The hymen is often torn during the first coitus (intercourse).
However, it can also be broken by a sudden fall or jolt, insertion of a vaginal tampon, active participation in some sports like horseback riding, cycling, etc. In some women the hymen persists even after coitus. Therefore, the presence or absence of hymen is not a reliable indicator of virginity or sexual experience.

69. **(c)** Uterine fundus is a part of uterus. Infundibulum, ampulla and isthmus are the parts of fallopian tube.

70. **(b)** FSH acts upon ovarian follicles in females and Sertoli cells in males.

71. **(c)** Breast feeding during initial periods of infants growth is recommended by doctors for bringing a healthy baby because colostrum contains several antibodies absolutely essential for develop resistance for new born.

(b)

	List-I		List-II
A.	Non-medicated IUD	III	Lippes loop
B.	Copper releasing IUD	I	Multiload 375
C.	Hormone releasing IUD	IV	LNG-20
D.	Implants	II	Progestogens

74. **(b)** Vaults are barrier methods of contraception while Lactational amenorrhea, Coitus interruptus, Periodic abstinence are natural/traditional method of contraception.

74. **(a)** Down's syndrome - 21st chromosomes
α-thalassemia - 16th chromosomes
β-thalassemia - 11th chromosomes
Klinefelter's syndrome - 'X' chromosome

75. **(c)** The process of copying genetic information from one strand of the DNA into RNA is termed as transcription.
The process of transcription is catalyzed by the enzyme DNA dependent RNA polymerase in only one direction, that is, 5' → 3', the strand of DNA that has the polarity 3' → 5' acts as a template, and is also referred to as template strand.
The given template strand of DNA is:
3'TACATGGCAAATATCCATTCA5'
So, the transcribed strand of RNA will be:
5'AUGUACCGUUUAUAGGUAAGU3'.

76. **(a)** The flippers of Penguins and Dolphins are analogous organs and thus are examples of convergent evolution, where different species have independently evolved similar traits to adapt to similar environments, like swimming in water.

77. **(b)** Gene pool (total number of genes and alleles in a population) will remain constant if a population is following Hardy-Weinberg equilibrium. The factors affecting Hardy-Weinberg equilibrium are: genetic drift, mutation, gene migration or gene flow, genetic recombination and natural selection.

78. **(b)** *Homo habilis* (A) → *Homo erectus* (D) → *Homo neanderthalensis* (C) → *Homo sapiens* (B).

79. **(d)**

	List-I		List-II
A.	Typhoid	IV.	Bacteria
B.	Leishmaniasis	III.	Protozoa
C.	Ringworm	I.	Fungus
D.	Filariasis	II.	Nematode

80. **(a)** Common cold is caused by rhinoviruses.
Haemozoin is toxic substance released from ruptured RBCs which were infected by malarial protozoa (*Plasmodium*).
Widal test is used for diagnosis of typhoid.
Allergy is exaggerated response of immune system caused by allergens (Dust mites etc).

81. **(b)**

List-I	List-II
Cocaine	Obtained from coca plant (*Erythroxylum coca*)
Heroin	*Papaver somniferum*
Morphine	Effective and sedative painkiller, very useful in patients who have undergone surgery.
Marijuana	Flower tops, leaves and the resin of *Cannabis sativa*

82. **(d)** X – *ori* and Y – *rop*
ori responsible for controlling copy number of the linked DNA.
rop codes for the proteins involved in the replication of the plasmid.

83. **(a)** The 'Ti plasmid' of *Agrobacterium tumefaciens* stands for Tumor inducing plasmid.

84. **(a)** Bio-reactors are used to produce large scale bacterial culture.

85. **(a)**

List-I	List-II
α-1-antitrypsin	protein is used to treat emphysema
cryIAb	controls corn borer
cryIAc	cotton bollworm
Enzyme replacement therapy	treat ADA deficiency

86. **(a)** Notochord is absent in non-chordate instead it is a characteristic of chordate. In non-chordate heart is dorsal (if present) but in chordate it is ventral. Post anal tail is found in chordate. Pharynx is perforated by gill slits in chordates. Central nervous system is dorsal in chordates whereas ventral in non-chordates.

87. **(a)** Goblet cells of alimentary canal is an example of unicellular glandular epithelium. Compound epithelium is found lining both dry surfaces, such as skin, and moist surfaces, such as the buccal cavity.
Salivary gland is an example of multicellular glandular epithelium.
Pancreas is a type of endocrine glandular epithelium. It secretes insulin and glucagon hormone.

88. **(c)** The structure used for storing food in cockroaches is Crop.
A ring of 6-8 blind tubules called hepatic or gastric caeca is present at the junction of foregut and midgut, which secrete digestive juice.
At the junction of midgut and hindgut is present another ring of 100-150 yellow coloured thin filamentous Malpighian tubules.
Gizzard helps in grinding the food particles in cockroach.

89. **(a)** Like mitochondria, the chloroplasts are also double membrane bound. Of the two, the inner chloroplast membrane is relatively less permeable.

90. **(c)** The correct sequential steps in the enzyme action is as follows:
E. Substrate binding to active site.
A. Substrate enzyme complex formation.
D. Chemical bonds of the substrate broken.
C. Release of products.
B. Free enzyme ready to bind with another substrate.

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91. (d) In ECG, The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria.
The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction.
The T-wave represents the return of the ventricles from excited to normal state (repolarisation). The end of the T-wave marks the end of systole.
T-P gap represents joint diastole of heart, in which heart muscles are electrically silent.

92. (a) In juxtamedullary nephron, the loop of Henle is very long and runs deep into the medulla.
Cortical nephron is present in majority w.r.t. juxtamedullary nephron.

93. (a) Three major regions make up the brain stem; mid brain, pons and medulla oblongata. Cerebrum is the part of forebrain.

94. (b) Exophthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, protrusion of the eyeballs, increased basal metabolic rate, and weight less, also called Graves' disease.
Acromegaly is the excessive secretion of growth hormone.
Cushing's syndrome is caused by excessive secretion of cortisol.
Cretinism is the hyposecretion of thyroid hormone during pregnancy which leads to stunted growth (cretinism), mental retardation, low intelligence quotient, abnormal skin, deaf-mutism, etc.

95. (c)
A - FSH
B - Leydig cell
C - Sertoli cells
D - Spermiogenesis
The increased levels of GnRH acts at the anterior pituitary gland and stimulates secretion of two gonadotropins luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate process of spermatogenesis. FSH acts on the Sertoli cells and stimulates secretion of some factors which help in process of spermiogenesis.

96. (c) If a child has blood group O^- (*ii*) so according to that both the parents should have at least one recessive allele (*i*). So correct answer is father (I^Ai) and the mother is (I^Bi).

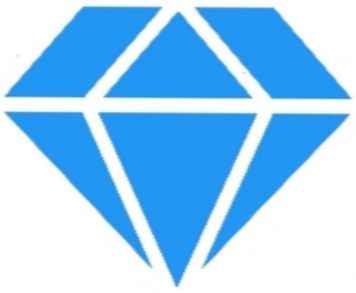
97. (b)
A. RNA Polymerase III - SnRNAs, tRNA
B. Termination of transcription - Rho factor
C. Splicing of exons - snRNPs
D. TATA box - Promoter

98. (b) Mesozoic Era - Birds and reptiles
Proterozoic Era - Lower invertebrates
Coenozoic Era - Mammals
Paleozoic Era - Fish and amphibians

99. (c) The primary lymphoid organs include both the bone marrow and the thymus. All blood cells, including lymphocytes, are produced in the bone marrow. Both the bone marrow and thymus offer micro environments crucial for the development and maturation of T-lymphocytes.

100. (b) Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.

TEGM Kohinoor



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